TAMPEREEN TEKNILLINEN YLIOPISTO
TAMPERE UNIVERSITY OF TECHNOLOGY

Sami Vihavainen

Field Studies on User Experience of Automation in Context-Aware Social Media

Julkaisu 1155 • Publication 1155

Tampere 2013

Tampereen teknillinen yliopisto. Julkaisu 1155
Tampere University of Technology. Publication 1155

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Thesis for the degree of Doctor of Science in Technology to be presented with due permission for public examination and criticism in Tietotalo Building, Auditorium TB109, at Tampere University of Technology, on the 4th of October 2013, at 12 noon.

Tampereen teknillinen yliopisto - Tampere University of Technology
Tampere 2013

ISBN 978-952-15-3134-7 (printed)
ISBN 978-952-15-3153-8 (PDF)
ISSN 1459-2045

Supervisor	Professor Kaisa Väänänen-Vainio-Mattila Department of Pervasive Computing Tampere University of Technology
Pre-examiners	Professor Oskar Juhlin Department of Computer and Systems Sciences Stockholm University
	Professor Marko Nieminen Department of Computer Science and Engineering Aalto University
Opponent	Associate Professor Anind Dey Human-Computer Interaction Institute Carnegie Mellon University

Abstract

Today's social media services increasingly contain highly automated context-aware features. However, there is scant research on understanding how automation affects user experience and what are the related issues, which should be taken into account when designing social media services. This thesis starts to fill this gap through empirical user studies and by forming design implications for automation in social media services from a user experience point of view.

Many popular social media services have introduced automatic context-aware means for social interaction. For example, users are able to automatically assign location information to their status updates on Facebook and Twitter, and information about a movie one is watching on the online movie service Netflix, can be automatically and instantly sent to the user's Facebook profile for friends to see. Human factors research has shown that automation has benefits and costs. On the one hand, it can free humans from performing nuisance tasks; on the other hand, it changes the role of the human user in the task performance loop by making the human a passive supervisor, which can decrease for example manual skills and situation awareness.

This thesis belongs to the field of human-computer interaction. The research takes a cross-case approach on the results of several field studies in which users used context-aware social media technologies in real-life contexts. The studies cover topics such as automatic location sharing, mobile notifications, and automatic video remixing, and majority of the studies were in mobile context. Altogether, 132 users participated in the studies. Individual interviews, data logging, and questionnaires were used as the primary data gathering techniques. In the cross-case analysis, the results were categorized under three themes: automation in input of information, automation in output of information, and automation in collaborative media generation. The benefits and costs of automation in each category were discussed. In addition, broader design implications are proposed to guide automation design of social media services into a direction where automation can support user experience.

The results convey that automation is capable of supporting users in pragmatic tasks. In addition, if the level of automation in the execution of the pragmatic tasks is also in agreement with user's hedonic (emotional) goals, automation can support a positive user experience. However, at the same time automation assists the user, it also lowers user control. This thesis shows that it can be challenging for the user to, for example, correctly interpret automated social information, sustain satisfactory privacy, and control the impression other people form of them. To conclude, this thesis proposes five implications for design that emphasize the application of alternative levels of automation to achieve a pleasant user experience with social media services.

Acknowledgments

Now that the journey of conducting my doctoral thesis is ending, I am happy to look back, and thank and acknowledge all of the most important people and collaborators that have made all this possible. There are three people who have been the most influential to my work—the giants whose shoulders I have been standing on during the last years. First, I would like to express my very great appreciation to my supervisor, Professor Kaisa Väänänen-Vainio-Mattila, from the unit of Human-Centered Technology (IHTE), Tampere University of Technology (TUT). Her patience, guidance, helpful critiques, and availability to assist me throughout this whole journey have been very valuable. Second, from the very beginning of my research, two of my colleagues from the Helsinki Institute for Information Technology HIIT, my former group leader, Dr. Risto Sarvas, and Dr. Antti Oulasvirta, have given me tremendous guidance and support on these winding roads of academic research. I am also in great debt of gratitude to Risto and Antti for their methodological and theoretical advice related to the field of human-computer interaction. Not only that, but they were also inspiring, outspoken, and fun colleagues to work with.

My background is in automation engineering. However, while doing my master's thesis I became interested in learning more about human-centered view of technology. A place par excellence to get involved in that field was HIIT (a joint unit of Aalto University and University of Helsinki), which I joined in 2005, thanks to my former manager, Dr. Anu Seisto from KCL (currently VTT (Technical Research Center of Finland)), HIIT's contemporary director, Professor Martti Mäntylä, and the leader of Digital Content Communities (DCC) research group, Professor Marko Turpeinen. HIIT has provided me an extremely dynamic, flexible, and multidisciplinary place to work. The people from Self-Made Media (SMM), Digital Content Communities (DCC), and Ubiquitous Interaction (UIx) research groups have all been tremendous. They have shown me how to view technology from many different points of view, including social psychology and cognitive science. HIIT has also provided me with safe surroundings in which to work. We have always worked out funding issues in case there were any project gaps. For that, I want to thank Marko Turpeinen, Risto Sarvas, Antti Oulasvirta, Olli Pitkänen, and Network Society's (NS) research program leader, Professor Giulio Jacucci.

The results of the thesis were born from several different research projects, which were funded mainly by TEKES (the Finnish Funding Agency for Technology and Innovation) or the Academy of Finland. Further, projects with VTT and KCL had a significant role in the thesis. The final pushes for this work were the personal grants from Nokia Foundation, Telia Sonera Finland's Research and Training Foundation, and the Jenny and Antti Wihuri Foundation. In addition, funding from Tampere University of Technology (TUT) during those final steps of the

work was crucial. These grants enabled me to concentrate on finalizing the last two articles and stringing together the pieces of the different projects and articles into a synopsis. I am very grateful for that funding.

This thesis was pre-examined by Professor Oskar Juhlin, from Stockholm University, and Professor Marko Nieminen, from Aalto University. I am very appreciative for the in-depth and useful reviews done by these respected pre-examiners. I am also very delighted and honored that Associate Professor Anind Dey, from Carnegie Mellon University, pledged himself to act as an opponent for me. Due to his achievements in the field of Human-Computer Interaction, and particularly in context-aware computing, he is by far the best possible opponent I can think of.

None of the publications would have reached their final form without my inspiring and hard-working co-authors. In many ways, this was a group work and I learned so much from you. For co-authoring, I want to express my appreciation to Francesco Cricri, Igor Curcio, Maija Federley, Timo Kuula, Airi Lampinen, Asko Lehmuskallio, Lassi Liikkanen, Sujeet Mate, Antti Oulasvirta, Risto Sarvas, Lassi Seppälä, Suvi Silfverberg, and Kaisa Väänänen-Vainio-Mattila.

In addition to the previously mentioned people, the work would not have been completed without a myriad of smart and enjoyable colleagues from HIIT, collaborative organizations, and other experts with whom I have had the privilege to work on various projects and/or have had inspiring discussions related to the projects and the thesis. For great collaboration and discussions, I want to thank Antti Aikala, Judd Antin, Andrea Botero, Asta Bäck, Coye Cheshire, Risto Helkiö, Herkko Hietanen, Kai Huotari, Mikael Johnson, Anu Kankainen, Kimmo Karhu, Kai Kuikkaniemi, Erkki Kuisma, Esko Kurvinen, Otso Kähönen, Raimo Launonen, Vilma Lehtinen, Jamie Munger, Mor Naaman, Jaana Näsänen, Janne Pajukanta, Arto Puikkonen, Mika Raento, Antti Salovaara, Ano Sirppiniemi, Sauli Tiitta, Mikko Villi, and Pirkka Åman. My special appreciation also goes to the convivial and hard-working staff of HIIT/Aalto and IHTE/TUT, who smoothed the everyday work. In addition I want to extend my sincere gratitude to all the 132 voluntary participants who were involved in the field studies of this thesis.

In the beginning of my research, I had the privilege of spending 1.5 years at University of California Berkeley's School of Information. That time set the frame for my thesis in many ways. Berkeley and Silicon Valley gave me a great opportunity to see and learn how to research information technology. It was also a great chance to gather interesting research data. Related to that, my discussions with Antti Oulasvirta at Berkeley were very important for the subject of the thesis. For the opportunity for this visit, for making that period very special, and helping in practicalities many thanks go to Professor Nancy Van House, Risto Sarvas, Anu Seisto, Marko Turpeinen, Martti Mäntylä, Esa Torniainen, Tommo Reti, the colleagues from iSchool, the staff of iSchool, and the main funding organizations TEKES and KCL.

I also want to thank my relatives and friends in Finland and my friends in the USA, who have supported me during this time and shown great interest in my research—which, for many, seemed to basically involve dishing out free phones for people to use.

I want to express my gratitude to my parents, Aila and Harri, my sister Maarit, and her husband, Petri. They are the ones who have followed my path the longest and there was no moment in my life where I could not have trusted their support.

Lastly, Päivi, my beloved wife, has stood by me and showed tremendous empathy throughout the ups and downs of this journey. She has been just amazing!

I want to dedicate this thesis to my, at present, 15-month-old daughter, Pihla. Pihla, seeing how passionately you observe the world around you and challenge yourself every day, spurred me to challenge myself and complete this thesis.

Helsinki, August 2013 Sami Vihavainen

List of Publications

This dissertation consists of a summary and six publications. The publications, presented below, are referred to in the text by their Roman numerals I-VI.

I. Vihavainen, S., Oulasvirta, A., Sarvas, R. "I Can't Lie Anymore" - The Implications of Location Automation for Mobile Social Applications. Proc. of MobiQuitous 2009, IEEE Press, 1-10.

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Vihavainen, together with the co-authors, planned the study and wrote the article. Vihavainen had the main responsibility in planning and implementing the field study and was the main contributor in analyzing the data. As the first author Vihavainen was in charge of producing the publication.

II. Vihavainen, S., Väänänen-Vainio-Mattila, K., The Implications of Mobile Notifications for User Experience of a Social Network Service. International Journal of Interactive Mobile Technologies, vol. 7, no. 2, 2013, pp. 9-18.

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Vihavainen was the main contributor in designing and implementing the study and writing the article. Vihavainen gathered and analyzed all the data and with the help of the co-author wrote the article. As the first author Vihavainen was in charge of producing the publication.

III. Vihavainen, S., Mate, S., Seppälä, L., Cricri, F., Curcio, I. We Want More: Human-Computer Collaboration in Mobile Social Video Remixing of Music Concerts. Proc. of CHI 2011, ACM Press, 287-296.

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Vihavainen had the main responsibility in designing and implementing the study. Vihavainen analyzed the data and together with the co-authors wrote the article. As the first author Vihavainen was in charge of producing the publication.

IV. Vihavainen, S., Mate, S., Liikkanen. L., Curcio, I. Video as Memorabilia: User Needs for Collaborative Automatic Mobile Video Production. Proc. of CHI 2012, ACM Press, 651-654.

Vihavainen together with co-authors and colleagues designed the field study. Vihavainen was the initiator of the questionnaire study, and designed and implemented the questionnaire with support from the co-authors. Vihavainen analyzed the data and wrote a major part of the article. As the first author Vihavainen was in charge of producing the publication.

V. Vihavainen, S., Kuula, T., Federlay, M. Cross-use of smart phones and printed books in primary school education. Proc. of Mobile HCI 2010, ACM Press, 279-282.

Vihavainen, with the co-authors, designed and implemented the field study and analyzed the data. Vihavainen's contribution to the design, implementation and analysis was very significant. Vihavainen wrote a major part of the publication. As the first author Vihavainen was in charge of producing the publication.

VI. Vihavainen, S., Lampinen A., Oulasvirta A., Silfverberg S., Lehmuskallio A. The Clash between Privacy and Automation in Social Media. IEEE Pervasive Computing Magazine, In Press.

Vihavainen was the initiator in writing the publication. Together with the co-authors Vihavainen analyzed the data, and planned and wrote the article. As the first author Vihavainen was in charge of producing the publication.

Table of Content

Introduction

1.1 Background and Motivation

Never before has automation affected people's lives as it does now. Automation is utilized extensively in computer-supported human activities ranging from product manufacturing to operating power plants, interacting with robots, flying aircraft, and air traffic control. Nowadays, automation is increasing in everyday life. Mark Weiser (1991) introduced the concept of ubiquitous technology and forecasted that, in the ubiquitous world, computers will vanish into the background. In ubiquitous computing, the system works undercover from humans. Thus decisions and functions will be transferred from human to machine, i.e. automated.

The use of social media is nowadays immensely popular and global. According to The Nielsen Company (2010), three of the world's most popular brands online were social media-related (Facebook, YouTube, Wikipedia). In Pew Research Center's (2011) survey on social network service (SNS) use, in 15 of 21 countries at least 25% of respondents used social network sites such as Facebook. Social media is used in myriad ways depending on the service and the user's motivations. In social media settings, people present their identities, have conversations with each other, share content (e.g., videos and photos), reveal their presence, build relationships, build reputations, and form communities (Kietzmann et al. 2011).

Present day social media services have more and more context-aware abilities. A user's music listening habits can be determined in real time and disclosed to her contacts on an SNS. Also, mobile devices such as smart phones are increasingly ready for context-aware features. Sensors such as GPS sensors, magnetometers, and accelerometers enable the phones to examine and react to users' changing contexts. For example, social network services such as Facebook, Twitter, and Foursquare have introduced features for the automatic disclosure of location information. Users of Facebook and Twitter can now automatically assign location information to their status updates. On Foursquare, users can automatically "check in" to physical locations and disclose it to others. These are only the early signals of automation in social media, and there is more to come: with mobile devices and other everyday objects becoming more ubiquitous and increasing their context-aware capabilities, more and more of users' social interaction-related tasks can be allocated to a computer. For example, the ContextPhone platform developed in 2005 records data from 16 different types of sensors, which then can be used to trigger actions within a

service that uses the data (Raento et al. 2005). A commercial application for ContextPhone was a mobile presence and communication application called Jaiku. With Jaiku, a user's location information is acquired and propagated among the user's contacts automatically, without any user involvement. A more recent example of increasing context awareness is the Android operating system-based Funf (Aharony et al. 2011), which is able to record data from over 30 different built-in mobile phone data probes (Funf 2013) .

The historical justification for automation has often been productivity and efficiency. Similarly, in social media, automation can potentially enhance the efficiency of the user by easing the user's burden, for example, in awareness and content creation tasks. However, the context of automation in, for example, a power plant is very different from the context of everyday use of a social media service. It is not evident that, in the development of social media services, it is enough to aim for increased efficiency and productivity. In addition, human factors research has shown that automation is a double-edged sword. It changes the role of the human in the loop to be more that of a supervisor, with effects on situation awareness, trust, mental workload, and understanding (Sheridan & Parasuraman 2006). Automation may have unexpected consequences for the user experience of a social media service. This is why it is of the utmost importance to study the user experience implications of introducing automation to processes that are inherently social by nature and not for example productivity-related.

1.2 Objectives and Scope

The objective of this thesis is to create a new understanding of how automation in context-aware social media services affects the user experience of the service. Parasuraman et al. (2000, p.287) defined automation as "the full or partial replacement of a function previously carried out by the human operator." This thesis bases its definition of automation on Parasuraman et al. (2000) with some adjustments. The term *automation* is used here to refer to the full or partial replacement of the human in the act of information processing. *Context-aware social media services* refers to social interaction supporting Internet-based services, where the service examines and reacts to the user's changing context. This definition is based on Kaplan and Haenlein's (2010) definition of social media and Schilit et al.'s (1994) definition of context-aware software.

Furthermore, the objective is to provide implications for design so that designers can better take into account the possible effects, both negative and positive, of automation for the user experience. The objectives will be reached by examining the implications of automation on the user experience in five independent case studies and one cross-case study. The scope of the

thesis is in the evolving context-aware social media services and on studying how automation is used and responded to by the end users in everyday contexts.

The thesis addresses the following two research questions:

RQ1: How can automation support the user experience in context-aware social media?

This question aims at addressing how allocating social interaction-related information processing tasks to a computer could assist a user in the use of social media and enhance a service's user experience.

RQ2: What challenges does user face with automation in context-aware social media?

This question aims at addressing how automation fails to fill or has difficulties in filling its idealistic goals and of the resulting negative effect on the user experience of the service.

1.3 Research Approach

This thesis belongs to the field of human-computer interaction (HCI). HCI is about designing interactive computer systems to be effective, efficient, easy, and enjoyable to use (Dix et al. 2003, p.xvi). HCI is a multidisciplinary field of research and can be considered a subfield of computer science. The multidisciplinary nature of HCI emerges in this thesis. Regarding technology, this thesis is mainly at the crossroads of the research fields of automation in human factors, social media, and context-aware computing. In addition, the perspective is user experience (UX) research. In a nutshell, this thesis is about the *user experience implications* of introducing *automation* into *context-aware applications* that are inherently *social* in nature. Methodologically, the thesis follows Yin's (2009) case study approach, meaning that use of case technologies are studied in real-life types of contexts. The case studies deal with the following social media contexts: location awareness, mobile notifications, collaborative video remixing, mobile learning, and privacy in social media. These cases offered a diverse set of interesting and evolving contexts and made it possible to derive a fairly comprehensive cross-section of the matter. Most of the cases are related to mobile technologies. However, although mobility has a unique influence on human-computer interaction (e.g., allowing ubiquitous and continuous access to social media services; see Oulasvirta et al. 2011), the thesis does not concentrate on mobility per se. The focus is on context-awareness and how tasks are allocated between human and computer. The mobile phone is an excellent application domain for context awareness, but context-awareness also goes beyond mobile phones (Schmidt & Van Laerhoven 2001). All the

case studies were field trials where the objective was to let people use technology as part of their everyday lives and real contexts of use, and study how technology integrates into their practices. In addition, a majority of the case studies are qualitative but also include quantitative data logs and questionnaires.

1.4 Contribution of the Thesis

The contribution of this thesis is the combined results of the case studies on designing automation for context-aware social media services. The contribution of the thesis has three main parts. *Conceptually*, understanding of processes, where automation may support the user experience of a service, and where a user may face challenges with automation while using a service, is increased. This is provided by the cross-case analysis of the independent case studies. Furthermore, the conceptual understanding is focused on the points of view of the user whose information is disclosed (output), the user who receives the information (input), and collaborative generation of media. *Empirically*, the field trials with specific case services provide detailed descriptions on how users interacted with the automation of context-aware social media features in the contexts of location sharing, teacher-pupil interaction, mobile notifications, and mobile video productions. *Practically*, the empirical and conceptual contributions are combined as practical implications for design. Given that, nowadays, through the programmable nature of digital devices and services and the advancements in context-sensing technologies, the possibilities for automating tasks have become increasingly broad, it might be tempting for the designers to automate tasks simply because it is possible. The thesis proposes five automation related design implications that assist designers in creating a pleasant user experience in context-aware social media services.

1.5 Structure of the Thesis

The thesis consists of eight chapters and is structured as follows. After this introductory chapter, Chapter 2 introduces the reader to other relevant academic work that is related to the thesis' subject. This contains definitions and frameworks for automation from human factors research, context-aware computing, social media, and user experience. In addition, a group of user studies at the crossroads of automation and context-aware social media is discussed. In Chapter 3, the research methods and data analysis techniques employed during the PhD research are introduced. Chapter 4 briefly introduces the case studies the author conducted during the PhD research.

Chapter 5 presents the results of the thesis. The results follow the research questions and are divided into two sections. Chapter 6 presents and discusses the design implications. Finally, Chapter 7 summarizes the results of the thesis and suggests topics for further research.

2. Related Work

This chapter presents the related work from four perspectives that outline the scope of this thesis. First, the traditional human factors view on *automation* and *context-aware computing* are discussed, as well as the common ground of the traditional automation and context-aware computing. Second, the concept of *social media* is introduced with reference to earlier research. In addition, some computer-supported collaborative work (CSCW) and groupware literature will be reviewed to show similarities to social media literature. Third, the concept of *user experience* is introduced through several definitions and descriptions from related literature and positioned as it is understood in this thesis. Finally, a group of related *user studies* is presented, and the *research gap* is described.

2.1 What is Automation – Definitions and Implications

Automation is utilized increasingly in human activities and nowadays ranges beyond product manufacturing to power plants, cars, robots, air conditioning, elevators, business systems, and medical devices, to name a few. The *Oxford English Dictionary* defines *automation* as "the fact of making something (as a system, device, etc.) automatic." Furthermore, it defines *automatic* as "of a machine, appliance, etc.: that does not require an operator; that works by itself under fixed conditions, with little or no direct human control" (OED Online 2013). By applying this definition of automation to today's social media world, it can be seen that a lot of things in social media are nowadays automated. Facebook suggests new friends to the user, the algorithm behind Facebook Newsfeed decides what news to show and what not, and a mobile phone's text messages try to predict and complete words based on the first letters written by the user. Sometimes automation gets it right, and sometimes not. The consequences of automation failing in social media surroundings cannot be said to be as severe as those that occur upon automation failing in for example nuclear power plants, such as the Three Mile Island disaster (Norman 2002). Although severe examples have also documented (The Bolton News 2011), the unwanted consequences are mostly not life threatening. This does not mean that it would not be important for automation to work in social media settings, too. As it will be later discussed, automation can in many ways be an essential part of the user experience of social media service, and, if

unsuitable, can have a negative impact on user experience, even causing the user to neglect using the service altogether.

2.1.1 Human Factors of Automation

In recent decades, automation has been studied extensively in human factors research (Parasuraman & Riley 1997; Sheridan 2002; Fereidunian et al. 2007). Traditionally, automation has been applied to increase cost effectiveness, reliability, and accuracy. These are valid motivations unless they have a negative effect on human and eventually system performance. Human factors research has shown that automation is a mixed blessing. It changes the role of the human in the loop with effects on understanding, control, skill, vigilance, and, ultimately, trust and usefulness (Sheridan & Parasuraman 2006).

The classic problem from the beginning of computerization has been the function allocation between human and computer. It was addressed in the 50s by Fitts (1951, cited in Sheridan 2002) in his well-known MABA-MABA categorization, referring to "men are better at" and "machines are better at." While this list, which says, for example, that "men are better at exercising judgment" and "machines are better at responding quickly to control signals," has been criticized for being incomplete (Jordan 1963; Jones & Jasek 1997; Woods 1996; Hoc 2000), it has also been recognized as a valuable reminder that people and machines are complementary (Sheridan 2002). The complementarity and collaboration between the user and the system is a core view in this thesis too.

2.1.1.1 Benefits and Costs of Automation

It is generally agreed, on the one hand, that automation is valid in functions where measurements are accurate, variables constant, and reactions need to be fast. On the other hand, humans are better in handling abstract problems where variables are ill defined and off-nominal events occur (Parasuraman et al. 2008). Automation has been reported to have several benefits. When successfully implemented, it can relieve humans from having to do nuisance tasks, increase flexibility of operations, reduce human errors, and increase efficiency (Scerbo 1996). Scerbo (1996) notes that Wickens (1992) categorized automation into three main classes, depending on purpose. First, automation is used when a machine can perform functions that are beyond a human's ability. Second, automation is used for performing tasks that humans do poorly. Third, automation is used for performing tasks that are undesirable for humans to do. Automation also has costs. When tasks become highly automated, it shifts the humans' role to that of the passive supervisor. The problem with this is that humans are not good at passive

monitoring for extended periods (Warm 1984). It has also been argued by Wiener (1989) that in some cases automation can even increase humans' mental workload, especially because automation can become a burden during high-workload situations. In addition, by changing the human operator to be more like a supervisor in the task operation loop, using automation can decrease the human's manual skills and situation awareness. As a matter of fact, Bainbridge (1983) argued that, ironically, automation may actually increase the human workload because it increases the need for human supervision and there is still need for a human to take over in abnormal conditions. Norman (1990) proposed that the main reason for the increased need for human supervision is that automation in many cases is just not smart enough, and therefore the problem is not in increasing automation but poor design. In addition, costs of automation related to conflicting goals and trust have been reported. Woods (1994) argued that in complex systems there might be conflicting goals between subsystems (cited in Scerbo 1996). Lee and Moray (1992) brought up that a user's confidence in herself as a user and in the automation impacts the usage of the system. Also, overreliance can happen. If the user has learned to trust the system, she might feel reluctant to evaluate or even supervise the system's activities (Parasuraman et al. 1993)

2.1.1.2 Control and Levels of Automation

In the simplest mode, a system can be either fully automatic or fully manual. For example, in a car's fully automatic air-conditioning system, a thermostat automatically maintains the preset temperature. In a more basic form of air conditioning there is no thermostat, but the driver has to control the temperature manually with a switch that adjusts the temperature of the airflow. This she does based on how warm or cold she perceives the environment's temperature to be. In this example, the task that is automated is the sensing of the environment's temperature and, based on that, executing the airflow adjustment function. As said, this "all or nothing" approach is the simplest form of automation. However, automation is not all or nothing. Parasuraman et al.'s (2000) model, also referred to as Sheridan's model (Fereidunian et al. 2007), which originated from human factors research, emphasizes this and states that automation can be executed on various levels ranging from no automation to complete ignorance of the user. Their model contains ten levels of automation, each offering a certain amount of feedback (informing the user about the system's doings) and/or control (Table 1).

Level	Description
	The computer…
High 10	decides everything and acts autonomously, ignoring the human.
9	informs the human of a decision only when it chooses to do so.
8	informs the human of a decision only when the human asks.
7	executes automatically, and then informs the human of each decision.
6	allows the human a restricted time to veto before automatic execution.
5	executes a suggestion if the human approves.
4	suggests one alternative.
3	narrows the selection down to a few alternatives.
2	offers a complete set of decision/action alternatives.
Low 1	offers no assistance: the human must execute all decisions and actions.

Table 1. Levels of automation according to (Parasuraman et al. 2000), ranging from no automation to complete ignorance of the user.

In addition, the level of automation can vary from one stage to another during the processed task. Parasuraman et al. (2000) proposed a four-stage model of system functions (Figure 1), which they based on a simplified model of human information processing discovered by information processing and cognitive psychology. Their goal was to propose a structure that was useful in practice and not to debate the theoretical aspects of the human cognitive system. The four stages of the model are *data acquisition*, *data analysis*, *decision selection*, and *action implementation*. *Acquisition* refers to the stage of a task during which the raw data are acquired. For example, when a phone's GPS sensor acquires location data, it is executing the acquisition stage. *Analysis* refers to the stage when the acquired data are analyzed, such as aggregating or comparing them with other data. For example, when two or more location data points are analyzed in relation to time, the object's velocity can be calculated. *Decision selection* refers to the stage when a selection is made among decision alternatives produced in the analysis phase—for example, the information's form and accuracy level. *Action implementation* refers to the stage when the actual action is executed.

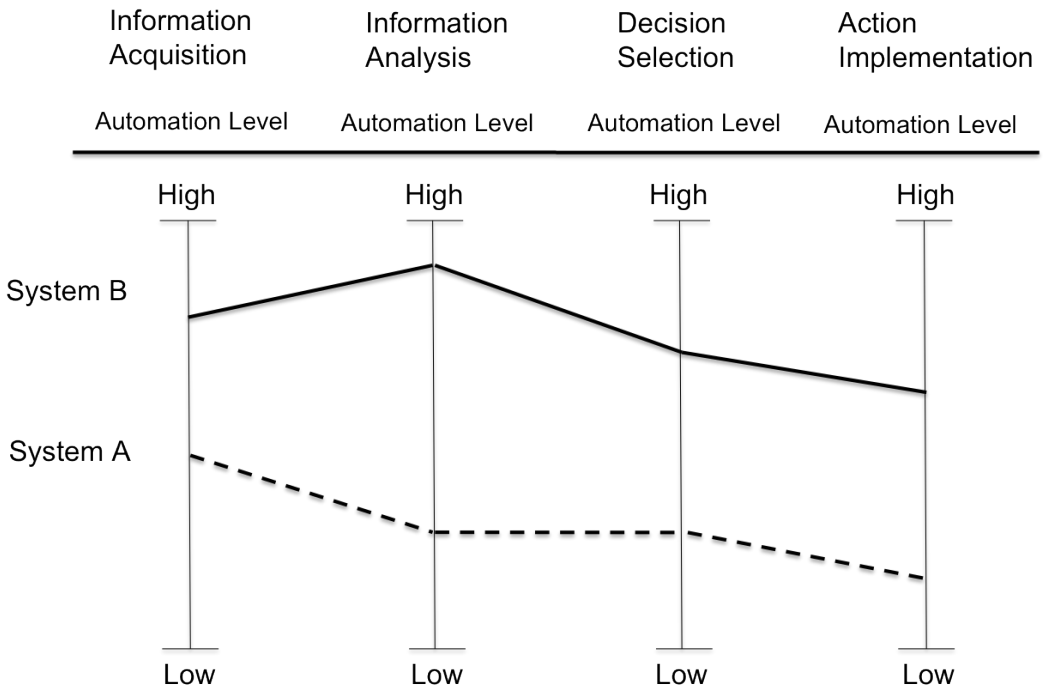

Figure 1. Levels and stages of automation according to (Parasuraman et al. 2000). As an example, system A and system B differ in their level of automation in different automation stages.

As the functions are automated, the human's role in the task performance loop is changed, and control is transferred from human to machine (and one could also say from the user to the designer of the machine). The question is: how much control is feasible to transfer to the machine so that it works to enhance user experience but does not make the user like the service less because of loss of control? When services start to autonomously acquire and analyze data, make decisions, and implement actions, users might feel they are out of the loop.

Psychology research talks about perceived control. Generally, control refers to "the extent to which an agent can intentionally produce desired outcomes and prevent undesired ones (Skinner et al. 1988). When individuals believe they can do this, they are said to have personal control, perceived control, or a sense of control" (Skinner 1996, p. 554). In information systems, perceived control has been found to affect users' motivation to use the system. For example, Novak et al. (2000) studied the use of e-commerce websites and found that perceived control is a major factor in determining the flow experience with the system, which again affects the depth of interaction. Also in HCI, earlier research has established the notion of control as an important concept in social interaction-related ubicomp services (Bellotti & Sellen 1993; Iachello & Hong 2007; Patil & Kobsa 2009). Averill (1973) categorized personal control as behavioral, cognitive, and decisional. Behavioral control refers to "availability of a response which may directly influence or modify the objective characteristics of an event" (p. 286). Thus, behavioral control

is more actual control than just perceived control (Swartz & Iacobucci 2000). If restricted, it restricts the user from performing a particular behavior. Cognitive control refers to "the way in which an event is interpreted, appraised, or incorporated into a cognitive 'plan'" (Averill 1973, p. 287). For example, feedback about a system's doings could give a user cognitive control in a way that she can be cognitively prepared for future events. Finally, decisional control is regarded as "the opportunity to choose among various courses of action" (Averill 1973, p. 287). For example, a user can actually influence how the system works by selecting the way she prefers.

Comparing Averill's control categories and Parasuraman's and Sheridan's levels of automation, a connection between the levels of automation and perceived control can be found. If automation is at the highest level, where the system ignores the human completely, it narrows the human's ability to decide between alternative ways to perform the task, and the user is not informed about the system's doings so that she could be prepared for future events after the task is performed. Therefore, automation lowers the human's decisional and cognitive control to a minimum in system usage. It also lowers the user's behavioral control of events, as the user is not well informed about the system's doings. Seeing automation in this way can help designers imagine what kind of perceived control a user might lose as a result of increased automation.

Computer systems of everyday life have become ever more complex and "intelligent." Nonetheless, the question of labor allocation still remains the same and is ever more important in developing everyday life ubiquitous technology with good user experience (Russell 2005; Harper et al. 2008).

2.2 Context-Aware Computing – Definitions and Link to Automation

The term *context-aware software* was first introduced by Schilit and Theimer (1994) to mean software that "adapts according to its location of use, the collection of nearby people and objects, as well as the changes to those objects over time" (p. 22). Schilit et al. (1994) described systems that examine and react to an individual's changing context. They stated that such systems can mediate people's interactions with devices, computers, and other people. The first research on a context-aware system was that of Want et al. (1992), who studied a building-based location system, Active Badge, in an office working environment. They used wearable electronic ID badges to automatically disseminate the locations of the participants. The building had detectors that recorded the participants' locations every 15 seconds. Using a computer, the user was able to locate the participants on a map or a textual interface. The system also showed who were in the same room with each other and the nearest telephone number.

To further develop the definition, Dey and Abowd (1999) reviewed several papers defining context-aware computing (e.g., Schilit & Theimer 1994; Ryan 1997; Kortuem et al. 1998) and used them as a starting point for broader definition of *context-aware system*: "a system is context-aware if it uses context to provide relevant information and/or services to the user, where relevancy depends on the user's task" (p. 6). They defined *context* as "any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves" (p. 3). Dey and Abowd (1999) presented *location, identity, time, and activity* as the primary context types necessary for characterizing the situation of a particular entity. They also categorized the features of context-aware applications: *presentation* of information of services to a user, *automatic execution* of a service, and *tagging* of context to information for later retrieval. From this thesis' point of view, the automatic execution of a service is the most relevant. More precisely, by the automatic execution of a service, Dey and Abowd (1999) meant that the service is able to execute or modify a service automatically based on the current context. Schilit et al. (1994) called this feature *context-triggered actions*, and Pascoe (1998) called it *contextual adaptation*. Therefore, the term automation overlaps partly with context awareness. For the purpose of this thesis, Dey and Abowd's (1999) definition of context-aware is considered sensible and is used.

Nowadays, context-aware computing is evolving, especially in mobile media (Häkkilä et al. 2009); for example, mobile devices' automatically acquired location data are used in masses of off-the-shelf applications that people can use in everyday life (Dey et al. 2010). Smart phones, for example, have built-in sensors such as an accelerometer, magnetometer, and GPS sensor, which can be used for modeling the activities of the user. In addition, it is possible to acquire data about a user's interactions with the phone and the phone's interaction with surrounding devices (Lane et al. 2010). For example, the ContextPhone platform records data from 16 different types of sensors (Raento et al. 2005), and the Funf (Aharony et al. 2011) system is able to record data from over 30 built-in mobile phone data probes, which could then be used to trigger actions within a service that uses the data. However, context-aware systems are only able to make a limited description of the world. It is evident that a gap exists between how the system and the user perceive the context. Therefore, the challenge in designing context awareness is to find the proper feature space that acquires and uses data in a way that is good enough to model the world for the specific context-aware application (Schmidt 2013).

The main goal in developing context awareness is to increase the system's understanding about its surroundings. This, if successfully implemented, might match (or even exceed) the user's expectations on how the service should work in specific contexts. Context awareness can also make human–computer interaction more implicit, where the user does not actively interact with the computer but the computer understands the user's context as an input. This differs from

explicit interaction, where the user specifically tells the system what to do (e.g., through a GUI or a keyboard) (Schmidt 2000). On the other hand, explicit interaction, through intelligibility and user control, has been argued to be required for successful context-aware applications (Dey & Newberger 2009). According to Schmidt (2013), context awareness can be categorized under six themes: context-adaptive systems (proactive applications, function triggers, and adaptive applications) adaptive and context-aware user interfaces, managing interruptions based on situations, sharing context and context communication, generated data for metadata and implicitly user-generated content, and context-aware resource management systems. For example, context adaptive systems use context information to trigger functions on behalf of the user (ibid.). Although context awareness is evolving in today's technology, there are still challenges for designers. According to Cheverst (2012), two key challenges for designing context-aware features still exist. First, the behavior of the system should be predictable. Second, designers should keep the user in the loop and provide her a proper level of control on the actions of the technology.

The term *context-aware computing* is also often seen related to the concepts of ubiquitous computing, pervasive computing, and situated computing (Dourish 2004), of which the first two are often used interchangeably (Ark & Selker 1999; Dourish 2004) and the last one refers to a computing device's ability to detect, interpret, and respond to the user's local environment (Brodersen & Kristensen 2004).

2.2.1 Automation and Context-Aware Computing – The Common Ground

Comparing the definitions of the traditional human factors automation and context-aware computing, it can be seen that they do share a common ground. Schilit and Theimer's (1994) definition of context-aware software talks about software being able to *adapt* based on the context. Furthermore, Dey and Abowd's (1999) definition of context awareness talks about the *system using context* data to provide information to the user. Both these definitions contain the premise that the system executes a task by itself or with little human involvement, which is the core of Parasuraman et al.'s (2000) definition of automation. Drawing from this common ground, in this thesis, Parasuraman et al.'s (2000) model of automation is used as a structural guide to analyze the automated functions in the context-aware case services.

2.2.2 Context from the social science perspective

The context-aware literature viewed earlier in this chapter is mostly related to designing ubiquitous technologies, and the goal has been to design technologies that take into account the user's context so that they would better adapt to the user's practices. The motivation for this has originated from the social science and ethnographic criticism (e.g., Suchman 1987) that interactive technologies are often too rigid to take into account the details of people's actions (Dourish 2004). Although in this thesis context awareness is mostly used as a boundary between the studied technological systems, it is important to understand that there are different views related to the notion of context in the HCI literature. According to Dourish (2004), the views on context awareness presented in 2.2 (Schilit & Theimer 1994; Ryan 1997; Dey 2001) stand for a positivist view, which sees context as a representational problem. This, he argues, is popular in engineering due to the fact that software by nature seeks to model the world mathematically and is therefore interested in how context could be encoded and represented. In contrast to the positivist view, the phenomenological view sees context as a dynamic and highly nuanced property of practice among people. Therefore, from the phenomenological point of view the problem of how to understand context is not a representational one but an interactional. Dourish (2004) argues that the positivist view sees context as information that can be represented, delineable in advance, stable between instances of activity, and possible to separate from the action itself. On the other hand, the phenomenological view argues that context is something that rises continuously when people interact. Contrary to the positivist view, it is relational (something may or may not be contextually relevant to an activity), dynamically defined (changes in the course of action), occasioned (different in each occasion), and something that rises from activity (therefore activity creates the context so they are not separable).

2.3 User Experience – Definitions and Frameworks

For user experience (UX), there are multiple definitions and heterogeneous views (Law et al. 2009). For example, Allaboutux.org lists 27 definitions that are gathered from the literature and from the Web (All About UX 2012). Although definitions vary, there is also some consensus. Law et al. (2009) made a fairly extensive survey on the scope and definitions of UX. They found that there seems to be an agreement among researchers and practitioners (academic and industry) that UX is dynamic, context dependent, and subjective. There have also been attempts at creating a standardized definition. ISO standards, the most recent of which is ISO 9241-210 (2010), define UX as "person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service." The main theme in UX definitions usually is that UX overlaps

with usability but is something more than usability. According to ISO 9241-210, usability means the "extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." Although ISO 9241-210 does not systematically compare usability and UX, it seems that usability is more concentrated on how a specific task is accomplished using the technology, while UX is a broader view on the user's perceptions on the used technology.

Hassenzahl (2005) tried to determine what UX actually is. He divided the user's perception of products into two dimensions, *pragmatic* and *hedonic*, and argued that HCI should be concerned with both aspects of an interactive product. A product is pragmatic if it matches a user's behavior goals, and it is hedonic if it causes stimulation, identification (i.e. self expression, interaction with relevant others) and evocation (i.e. self maintenance and memories). By pragmatic he also means a product's ability to support the achievement of *do-goals*, whereas hedonic refers to *be-goals.* Do-goals focus on practical goals, such as making a telephone call. Be-goals, on the other hand, focus on higher-level goals, such as being related. Therefore, when one has made a telephone call, she has completed the actual do-goal, but also completed a higher-level be-goal. As a base of this do-be-goal model, he uses Carver & Scheier's (1998) hierarchy, which suggests that do-goals are derived from be-goals, in a way that they are instrumental for the accomplishment of a specific be-goal (Hassenzahl 2008). Be-goals, on the other hand, can be seen as equivalent to the basic psychological human needs (Hassenzahl 2007). There are many listings of human basic needs, such as Maslow's (1954) hierarchy of needs and Deci and Ryan's (2000) self-determination theory (Sheldon et al. 2001). Maslow (1954) lists physiological, security, social, esteem, and self-actualizing needs as the basic human needs. In Maslow's hierarchy, the basic needs must be fulfilled before moving to the higher, more complex needs. However, in later research the hierarchical nature of the needs has been questioned, and it has been found that humans can gain well-being by meeting the higher-level needs but not the basic ones (Tay & Diener 2011). Deci and Ryan (2000) listed three basic human motivations: competence (people want to feel effective in their activities), autonomy (people want to feel that their activities are self-chosen and self-endorsed), and relatedness (people want to feel a sense of closeness with some others) (Sheldon et al. 2001).

To get a more complete picture of the UX field, Hassenzahl and Tractinsky (2006) reviewed high-quality empirical research papers and looked at UX from three overlapping perspectives: beyond the instrumental, emotion and affect, and the experimental. By beyond the instrumental, they mean that concentrating on fulfilling of a specific task is too narrow for UX research, and is more related to usability testing. By emotion and affect, they want to emphasize that UX research is interested in how humans, through interaction with technology, can feel positive feelings like joy, fun, and pride. By experimental perspective, they emphasize that an experience is a unique combination of various situational elements such as the product and the internal state

of the user (e.g., the user's expectations and active goals), which also extend over time. As an example, they consider differences between "a tomato in a fridge" and "the taste of a marvelous tomato sauce on homemade gnocchi." This example shows how the product (a tomato) is used in a particular situation, which then forms an experience. They summarize that UX is a result of the user's internal state, characteristics of the designed system, and the context within which the interaction occurs (ibid.). Hassenzahl (2005) gives an example of the effect of the user's internal state by presenting two use situations: goal mode and action mode. In goal mode, the user's main motivation is to achieve a specific goal, but in action mode the user's main motivation is to find stimulation. In goal-achieving action, such as finding out a bus timetable, efficiency is important. However, in stimulation action, such as killing time by reading Facebook, requirements for efficiency are not that important. Therefore, the demands for positive UX can be different. The author states that each product can be used in both modes, and therefore the product should support both modes (ibid.).

In this thesis, UX is understood in line with Hassenzahl's (2005) distinction between pragmatic and hedonic perceptions. Moreover, the do-goal-be-goal model will be used in analysis of the case study results. As the focus of the thesis is in automation in social media, the model will be valuable since social media uses such as presenting identities, having conversations, sharing content, building relationships, building reputations, and disclosing their presence (Kietzmann et al. 2011; Kaplan & Haenlein 2010) are related to the be-goal of relatedness. To achieve that through the service, do-goals have to be accomplished. Simply put, the question is about experiences that fulfill people's basic social needs (e.g., relatedness) and so enhance quality of life.

UX can also be analyzed from different temporal perspectives. These can be single behavioral episodes with a beginning and an end (e.g., a period during which the user explores specific features of the technology), a momentary UX (e.g., a snapshot of emotions), or a long-term UX (e.g., using a product or service in everyday life) (Vermeeren et al. 2010). Measurement of momentary UX is often less time consuming and laborious than measuring long-term UX. However, measurement of a momentary UX is not a very reliable means for predicting the overall UX in real life and predicting the successfulness of a product or service (Kujala et al. 2011). Long-term UX informs better how the user's perception of the product evolves over time from feelings of novelty to becoming a part of everyday life. Studying long-term UX can also provide more comprehensive data on the emotions and experiences the user can achieve through technology (Hassenzahl 2013). However, studying long-term UX from example through field studies in realistic contexts is often laborious and time consuming (Kujala et al. 2011).

2.4 Social Media Services – Definitions and Privacy

Social media is a broad term. Kaplan and Haenlein (2010) used two related concepts, Web 2.0 and user-generated content, as a base and defined social media as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content" (p. 61). They grounded their definition on the notion of "Web 2.0," introduced by Tim O'Reilly (2005). However, whether or not a service is "Web 2.0" is not often very clear (Lessig 2006), and the notion has been criticized as being too loosely defined (developerWorks 2006). Along the effort of defining social media, the interesting contribution of Kaplan and Haenlein (2010) is their two-dimensional categorization of social media services, the first dimension being media, and the second social. These two dimensions, they find, are the key elements of social media. For the media dimension, they considered a set of theories in the fields of media research: social presence (Short et al. 1976) and media richness (Daft & Lengel 1986)). For the social dimension, they considered literature on social processes: self presentation (Goffman 1959) and self disclosure.

Related to the media dimension, Short et al. (1976) argued that media have differences in the level of social presence (i.e., "the acoustic, visual, and physical contact that can be achieved" [Kaplan & Haenlein 2010, p. 61]) they allow to emerge between communication partners. In addition, social presence is dependent on how intimate the communication channel is (interpersonal vs. mediated) and how immediate the interaction it facilitates is (synchronous vs. asynchronous) (Kaplan & Haenlein 2010). A similar kind of communication matrix has been introduced also in CSCW literature by Ellis et al. (1991). It is likely that social presence is lower in mediated (e.g., telephone) than interpersonal (e.g., face-to-face) communication, and also lower in asynchronous (e.g., email) than synchronous (e.g., instant messaging) communication (ibid.). According to Kaplan and Haenlein (2010), the level of social presence of the media affects how much impact the communication partners have on each other's behavior. Closely related to social presence, Daft and Lengel's (1986) concept of media richness assumes that the goal of communication is to resolve equivocality and to reduce uncertainty. They state that communication technologies differ in their effectiveness in achieving that goal.

Related to the social dimension, Goffman's (1956) notion of self presentation argues that in social interaction people want to be able to control the impression other people have of them. Another central notion related to social interaction, self disclosure, can be defined as "conscious or unconscious revelation of personal information (e.g., feeling, likes, dislikes) that is consistent with the image one would like to give" (Kaplan & Haenlein 2010, p. 62). Table 2 shows Kaplan & Haenlein's (2010) classification of social media. The horizontal axis is the degree of media

richness and social presence the service allows, and the vertical axis is the degree of self disclosure the service requires and type of self presentation it allows.

		Social presence/Media richness		
		Low	**Medium**	**High**
Self-presentation/ Self-disclosure	**High**	Blogs	Social networking sites (e.g., Facebook)	Virtual social worlds (e.g., Second Life)
	Low	Collaborative projects (e.g., Wikipedia)	Content communities (e.g., Youtube)	Virtual game worlds (e.g., World of Warcraft)

Table 2. Kaplan and Haenlein's (2010) classification of social media.

As a parenthesis, social media research has many similarities with the CSCW literature of the 1980s and 1990s. CSCW can be defined as "computer-assisted coordinated activity carried out by groups of collaborating individuals" (Baecker 1995, p. 141). However, historically CSCW research has been concentrated on work-related environments where tight hierarchy affects user acceptance of a service and there is often a common goal that the group shares. With social media, the ways and motivations for people using the services can be more heterogeneous than in office contexts. This sets varying demands for a social media service in the everyday context. Ackerman (2000) argued that exploring, understanding, and ameliorating the gap between social requirements and technical feasibility is one of the grand challenges of CSCW research. It is easy to believe that this also applies to the social media context. A prime example of this gap in social media is handling of privacy.

2.4.1 Privacy in Social Media

In recent years, privacy in relation to social media and context-aware computing has become a major research area in HCI (Barkhuus 2012; Iachello & Hong 2007; Patil & Kobsa 2009). Human activity is very flexible, nuanced, and context dependent, and to support human activity technical mechanisms should also be flexible, nuanced and context dependent (Ackerman 2000). This becomes evident especially with privacy. Goffman (1959) brought out that humans have highly nuanced behavior regarding how and with whom they wish to share information. This sets demands for social media services, which often have very simple models for access control, and it is nothing but self evident how privacy mechanisms should be designed. Often the social requirements the users have for the service can be difficult for technology to fulfill. A recent real-life example of the challenges of privacy is Facebook, which has continuously developed its privacy settings, although with varying user reactions. Some of the key moments of Facebook's

tempestuous history with privacy were discussed by boyd and Hargittai (2010). The authors presented different phases in Facebook's trajectory and argued that often the default setting in Facebook's new features is the one that promotes information sharing the most. This again often conflicts with users' privacy.

There have been many definitions for privacy. One of the first especially related to information technology was Westin's (1967) definition: "Privacy is the claim of individuals, groups, or institutions to determine for themselves when, how, and to what extent information about them is communicated to others" (cited in Minch 2004). Thus, if the user feels she is not in control of when, how, and to what extent information about her is collected and communicated to others, she can feel her privacy is violated. The question of control brings us to automation, the goal of which is to give the machine the control of tasks. If the tasks are somehow involved with sensing, analyzing, or disclosing the user's personal information, the question of privacy arises. In this thesis, a definition of privacy developed by the social psychologist Irwin Altman is followed. Altman's (1975) interactional approach conceptualizes privacy as the "selective control of access to the self or to one's group" (p. 18). The main part of this theory is the boundary regulation process, which means a dynamic process in which people optimize the level of openness and closeness of the self (or of one's group) to others. People's desires to interact with others, such as the preferred degree of closeness, vary over time and depend on the context. Therefore, privacy is an optimizing process. At times, people may want to have more or less interaction with others. To achieve this level of interaction, they attempt to control the level of others' access to self. In addition, Altman states that privacy is a matter of both information input and output. People try to regulate the information from others (input) and to others (output). Altman's theory has been popular in HCI research (Palen & Dourish 2003) and in research on social network services (SNS) (Karr-Wisniewski et al. 2011).

2.5 User Studies at the Crossroads of Context-Aware Social Media and Automation

A series of relevant user studies have touched on automation in context-aware social media. In the field of HCI, location awareness has been a major area to study. In concert with location awareness, the other major area has been privacy. In addition, there are a series of user studies that concentrate on a specific area of social media, such as photo and video sharing and sharing of music listening habits.

A great body of quality user studies on location awareness applications has been conducted in HCI. The earliest of the studies were conducted in the workplace context and not in socially more complex leisure environments. However, in recent years the focus has been more on

applications directed for use in everyday contexts. Many of these papers touch on automation and describe how automatic features were used or at least registered by the users, but only a few cover the issue systematically.

The history of user studies on context-aware systems starts with Want et al.'s (1992) study on the Active Badge, discussed in section 2.2. They studied a building-based location system called Active Badge in an office working environment and reported that the system had several advantages. For example, the number of incidences of telephone calls not reaching the correct person dropped. In addition, they reported problems related to privacy. Most people's first reaction to the personal location system was horror. However, after two weeks of mandatory use, many continued using the system voluntarily. Harper (1992) also used Active Badge location technology. He studied the use of Active Badge in social organizations of two research laboratories. He found that in a hierarchical organization, one's role within the moral order of the organization affects the acceptability of a new technology. For example, in the workplace, information on an employee's location may be accepted in the case of the receptionist, but not in the case of an individual researcher. Both Want et al. (1992) and Harper (1992) were pioneers in user studies on context-aware systems. However, they focused on the workplace environment, which lacks the social complexity of everyday life and does not take into account people's needs for social relatedness and self expression, which are key factors in UX of social media services. In addition, workplaces often have a formally specified hierarchy, and social relations are more static than in leisure time social groups.

In recent years, the emphasis of user studies has shifted more into leisure-type applications. Barkhuus et al. (2008) studied Connecto, a status- and location-sharing system that allows users to tag locations and share them, automatically or manually, on a mobile phone. Their goal was to understand how location sharing would work within a close-knit group of friends. They recruited two groups of friends to use Connecto. The users manually controlled the otherwise automatic location in situations where they wanted the location name to stay constant for others (e.g., when driving on a highway). They found that manual overriding of automatic information enabled achieving better communicativeness, but the users were not reported to do manual overriding for privacy reasons. Brown et al. (2007) studied Whereabouts Clock, a low-fidelity, location-disclosure desktop terminal, which enabled one to see if a family member is physically at "home," "work," "school," or "elsewhere." Location information of each family member was based on their mobile devices' current locations. The presumption in the study was that a natural aspect of a family's everyday life is to be up-to-date about other members' whereabouts and routines. They recruited five families, all of which used the clock quite actively and who reported no significant problems in its use. The study concentrated specifically on families and did not explore the social boundaries of the system with other types of groups. Iachello et al. (2005) studied Reno, the awareness application allowing querying the locations of friends and

disclosing one's own location to the friends. In Reno, the user was able to disclose location fully manually, automatically to selected contacts, or upon entering a pre-specified location. The results showed that participants hardly used the automatic features at all. The main reasons stated were that they did not fully trust the automation to work properly and they did not feel a subjective need for setting up the automatic features. The authors' conclusion was that automatic location disclosure in Reno was useless.

Automation in social media has been studied in contexts other than the popular location awareness, such as in photo and video capturing and sharing and sharing of music listening habits. Sarvas (2006) touched on automation in the photo capturing, annotation, and sharing context. He studied designing of user-centric metadata for digital snapshot photography and conducted a series of user studies on the matter. From the automation point of view, the results revealed that since metadata information is semantic, dynamic, and contextual, it is very difficult to generate it automatically only. The results also showed that even the most basic automatically generated metadata could not be fully trusted. Silfverberg et al. (2011) studied people's automatic disclosure of music listening habits in the Last.fm service. They found that people tended to change their music listening habits in order to control their self presentation. Turning off or manipulating disclosed information content was often considered conflicting with the social norms of the Last.fm community. Girgensohn et al. (2001) conducted a user study in a domestic context on the Hitchcock video editing system. Hitchcock is a semi-automatic system where the user manually selects the preferred video clips and the system automatically synchronizes the video clips with the audio track. Their goal was to support home video editing with automated video analysis. The results demonstrated the need for balance between user control and automation in home video editing.

On the whole, in user studies of context-aware social media, automated features have been associated mainly with the following issues: understanding the user needs in relation to automatically generated and disclosed social content, communicativeness of automatically generated content, users' trust in the workings of automation, and a need to balance user control and automation. However, so far studies have concentrated on single systems, and a more comprehensive cross-case look on the costs and benefits of automation for social media UX has not existed.

2.6 Research Gap

As discussed in the earlier chapters, automation, context-aware computing, and social media have been widely studied in their own fields. In HCI, there have also been several individual user studies that concentrated on automation and context awareness in social media services.

However, the following research gaps still exist. First, a systematic view that would combine the three fields and concentrate on users' goals and needs related to automation (i.e., UX) is still limited. Second, studies on the UX in this context in real-life settings are quite rare and still insufficient. A reason for that is probably that well-working prototypes and off-the-shelf services have emerged only fairly recently and that real-life experiments, such as field studies, are time consuming and laborious to do. Although some individual user studies do exist, they are often focused on a specific area, such as location awareness or photosharing. There has not been any comprehensive research that would have approached the subject with a cross-sectional view. Third, there is a lack of comprehensive research on the benefits and costs of automation in social media contexts. Human factors research has discussed the benefits and costs of automation in, for example, the aviation and product manufacturing contexts. However, the focus there has been on the interaction between human and computer and not on interaction between humans, as it should be in social media. In social media, the nature of the services is inherently social and not, for example, production- and safety-related.

Therefore, this study concentrates on the crossroads of automation, context awareness, social media, and UX. The approach is to take a cross-sectional view by studying the UX of multiple social media services in real-life contexts. Furthermore, the objective is to start filling the gap by determining the benefits and costs of automation in social media services.

3. Research Methods and Techniques

In this section, the methodological approach of the thesis is described: what research methods and data gathering and analysis techniques were used. The field of research is HCI; more specifically, the thesis describes empirical research on social media.

Methodologically, the thesis follows a case study approach, meaning that case technologies are studied in real-life contexts. Yin (1994, p. 13) defines case studies as "an empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident." Case studies are well suited in research focusing on describing and explaining a phenomenon or for building hypotheses and theories (Kjeldskov & Graham 2003). Within the case studies, the main data-gathering approach of the thesis is a field study approach. In general, the main characteristic of a field study is that it takes place in "the real world" as opposed to laboratory settings (ibid.).

For years there has been debate in HCI on whether to conduct research in laboratory settings or in the field. Some scholars argue in favor of field studies (Nielsen et al. 2006), whereas others are against this approach (Kjeldskov et al. 2004). Field studies are often required when the phenomena do not fit or cannot be staged in a laboratory setting in a conclusive manner (Oulasvirta 2009). Using the case study approach and conducting field studies have gained interest among researchers in HCI. Especially researchers working on user-centered design and usability in applications on context awareness, mobile media, and augmented reality have questioned the adequateness of laboratory research settings (Abowd & Mynatt 2000; Carter et al. 2008). With laboratory settings, it has been problematic to capture the influence of the various ways the user is involved with the environment. Phenomena such as multitasking, interruptions, user practices, collective use, and technological infrastructures are some of the aspects hard to include in laboratory settings (Oulasvirta 2012). In addition, it is not meaningful to study factors related to social and organizational issues in laboratory settings.

3.1 Field Studies

In the case studies of the thesis, field studies were the ultimate selection since the objective was to discover the implications of automation on UX in everyday social settings. All the

publications (I–VI) involved settings in which a number of participants used the specific context-aware technology in their everyday lives. As Table 4 shows, in Publications I, II, and IV the participants used the technology for several weeks. In Publications III and IV, a one- to two-day field trial in a real-life, large-scale event was arranged after which users could use an event-related technology for several weeks in their own time. Publication VI was a cross-case study synthesis of three earlier published articles where no actual field study was arranged but the results of previously published studies were reanalyzed and synthesized.

	Publication I	Publication II	Publication III	Publication IV	Publication V	Publication VI
Users	25	11	19	51	26	a cross-case study
Period	2 months	2 months	3 weeks	4 weeks	3 weeks	a cross-case study

Table 4. Number of participants and the use period of studied technologies in each publication.

All the case studies were done using either functional prototypes or off-the-shelf services. Although studying the use of functional systems in real-life contexts was laborious, it was done in order to be able to effectively evaluate the implications of automation on UX. Abowd and Mynatt (2000) stated about the use of functioning prototypes: "Effective evaluation, in which users are observed interacting with the system in routine ways, requires a realistic deployment into the environment of expected use" (p. 49).

3.2 Data-Gathering and Analysis Techniques

The primary data-gathering techniques in the case studies were individual interviews, data logging, and questionnaires. In addition, pair interviews, focus groups, and personal diaries were used.

3.2.1 Interviews

For interviews, a semi-structured interview protocol was used in every case study. Semi-structured interviews are good if the interviewer wants to have some space to ask for clarification, add questions, and follow interviewee comments (Lazar et al. 2010). In this thesis, a semi-structured interview approach was used to allow for exploring the topic in a depth and

breadth that might have been difficult with a fully structured interview approach. However, in Publication II, a fully structured interview was also used in the form of an open-ended email questionnaire. In Publication II, some of the participants were not available for face-to-face interviews. Therefore, first the participants who were available for face-to-face interviews were interviewed in a semi-structured way. The results and experiences from those interviews were then used to formulate a fully structured interview protocol for the email questionnaire. In addition, in Publication V the pupils (children in elementary school) were interviewed in pairs to ease their nervousness during the interview.

3.2.2 Data Logging

Various forms of data logging were used to get objective quantitative data to be combined with subjective qualitative data gathered in interviews. In Publication I, the authors collaborated with the Jaiku Company. It was agreed that Jaiku would provide all the usage data from its server regarding the individual participants. In Publication II, users' Facebook accounts were monitored to get data, such as the frequency of updates to their status lines. In Publication V, automatic data logging was used to track how much pupils used mobile learning applications and to select pupils for face-to-face interviews.

3.2.3 Additional Data-Gathering Techniques

A web-based questionnaire was used in Publication IV to gather data on user perceptions on collaborative automatic video remixing. The questionnaire was done after the field trial. The questions included multiple-choice questions, open-ended questions, and Likert-scale questions where users selected their level of disagreement or agreement for a series of statements.

A focus group method was used in Publication III to gather various stakeholders' responses on the video remixing concept before the conducted field trial, and stakeholders' needs, views, opinions, and habits concerning video recording at live concerts.

3.2.4 Data Analysis Techniques

As an approach for the analysis of qualitative data, the principles of grounded theory (Strauss & Corbin 1990) were adapted. This meant that hypotheses were not formed before the study, but

the theories that were formulated were based on patterns that emerged from the data. As an analysis technique, content analysis (Zhang & Wildemuth 2009) was used. Content analysis has been defined as "a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" (Hsieh & Shannon 2005, p. 1278). Qualitative content analysis involves an inductive approach, where raw data are condensed into categories or themes and where the categories emerge from the data through the researcher's examination (Zhang & Wildemuth 2009). In the publications of this thesis, the notes and transcripts of qualitative data were first coded, meaning that the key points from the data were marked. After that, the key points were categorized and theories formed based on the categories. For coding and categorization, research questions of a particular case study were used for guiding the analysis. This kind of analysis was used in Publications I, II, III, and V. In Publication VI, the results of several studies were reviewed to identify privacy concern categories across multiple studies. In Publications I, IV, and V, for the analysis of quantitative data, descriptive statistical analysis techniques, such as median and mean, were used. In the analysis of questionnaire data in Publication IV, the non-parametric statistical test of the Mann-Whitney U-test (Conover 1999) was used to find significant differences between two groups of data.

4. Case Studies and Systems

This chapter presents the case studies of this thesis. Research settings and case systems are described. It will also be explained how the studied social media tasks are automated—that is, how the functions are allocated between the user and the system. The case studies of this thesis consist of five case studies and one cross case. The studies were location awareness (Publication I), mobile notifications (Publication II), two cases on collaborative automatic mobile video production (Publications III and IV), mobile learning (Publication V), and a cross-case study on privacy in social media (Publication VI). In the Results chapter, all the case studies will be analyzed from three perspectives: information input, information output, and collaborative generation of media.

4.1 Location Awareness (Publication I)

Publication I concentrated on UX of location awareness features in a mobile social application. In the study, the authors did a case study in the field using the Jaiku micro-blogging application that allows a group to share textual status updates that are associated with *automatic location information*. The goal of the study was to shed light on three questions: (1) How are automated features in mobile social applications used? (2) How do users respond to automation? and (3) How do users understand the logic of automation? At the time of the study, there was a growing body of user studies on location awareness emerging (e.g., Barkhuus et al. 2008; Brown et al. 2007; Consolvo et al. 2005; Harper 1992). Many of these papers note that automatic features were used or noted by the users, but only a handful gave the issue more weight.

In Publication I, the authors recruited three groups of eight to ten people in Finland and California: *The Students, The Birders,* and *The Hipsters*. Each group used Jaiku for two months. By studying three user groups' use of Jaiku, the authors' goal was to gain a more general perspective on the phenomenon, instead of gathering results from an individual user group. Individual in-depth interviews and quantitative data logs were used as the main methods of data collection.

The study showed how the automation-related questions are essential factors affecting user experience of location-based systems and should be taken seriously when designing context-

aware social media services. The results revealed that unsuitable automation might inhibit use in a group. When one of the groups found automated features useful for them, and another was indifferent toward it, the third group stopped using the service almost completely. The differences between the groups highlight the importance of needs, activities, and structures of the intended user groups as factors for acceptance of automation. Also, the study showed the importance of design decisions made in middleware and backend. Those can be critical regarding the user's understanding of how the service works and how to properly use it.

4.1.1 Jaiku – Systems Description and Automation Design

Jaiku is a Nokia S60-based mobile awareness service built on the ContextPhone platform (Raento et al. 2005). There are three key concepts, which are also central to the UI of the Jaiku mobile client: status messages, location labels, and awareness cues. Users can post status messages of 140 characters or less, which their contacts can view through a mobile app or an Internet browser. Next to the status line is a location status that serves as a label for the user's GSM cell. This feature is highly automated, as will be discussed next. In addition, Jaiku provides a separate screen with real-time, sensor-derived indicators (awareness cues) such as online status, alarm profiles, number of other people in proximity, and the next calendar event.

Regarding the location disclosure task (using Parasuraman's and Sheridan's [2000] levels and types of automation) at the *acquire* stage, Jaiku senses the user's location information based on her cell ID. This sensor is fully automatic and operates in the background (automation level 10). The system triggers the *analysis* stage whenever it senses the phone's cell ID changing, and it *analyzes* whether the new cell ID has a location name pair in Jaiku's database (level 10). Then, based on this analysis, Jaiku *decides* which location name to disclose (level 10). After that, it *implements* the location name disclosure. This implementation happens beyond the user's control, but the user can see the currently disclosed location name if she decides to open Jaiku and check what location name it is currently disclosing (level 8). Parallel to the implementation, the user is able to overwrite manually the disclosed location name at any time. That manual label is disclosed until Jaiku senses a new cell ID change.

In addition, Jaiku uses a crowdsourcing type of approach to accumulate a collaboratively user-generated location label pool (for more on crowdsourcing, see, for example, Estellés-Arolas & González-Ladrón-de-Guevara 2012). The users accumulate the pool as part of using Jaiku. In Jaiku, when the user manually writes a location name, the name will be saved in a collaborative location label database and used automatically as the user's contacts' location information when they are in that location. In other words, when Jaiku senses that the user is in a new location, it analyzes the location name database; if it finds a matching location label from the collaborative

database, it assigns that location name to the user. Therefore, the more users name their locations, the more comprehensive the location label pool will be.

4.2 Mobile Notifications (Publication II)

Publication II concentrated on studying the reactions to and use of automatic mobile notification as part of the Facebook experience. The goal was to find out how automatic push notifications affect UX of a mobile social network application. The authors did a case study in the field using the Socially mobile social media aggregator that allows the user to read and update her social media accounts and *automatically pushes social media notifications* to her phone's desktop. At the time of the study, mobile notifications were emerging in mobile social applications. However, there was no research concentrating on mobile notifications in social media from the UX perspective.

In the study, the author recruited 11 participants from the Greater Helsinki area in Finland and conducted a case study in the field where he first studied participants' Facebook use strategies and then use of the Socially application in concert with Facebook. The goal was to find the implications that automatic notifications produce for the UX of SNS. The results showed that most of the people who used the push notifications reported increasing reading of Facebook. However, after using push notifications for a while, many were unwilling to receive them automatically and felt the system limited their control of Facebook. For some, their Facebook experience felt more meaningful when they controlled it manually. Also, some did not use push notifications because they did not understand the logic of how the system works. Automation did work by assisting and increasing the following of SNS events. Increased following, manually and automatically, increased the frequency of updating SNS with status updates and links. However, automation failed in being too optimistically productivity- oriented and not flexible enough and on a proper level for pushing updates from heterogeneous SNS contacts to a personal mobile phone.

4.2.1 Socially – System Description and Automation Design

The Socially mobile application is a social media aggregator with an automated news feed push feature. With Socially, the user is able to read the Facebook News Feed (also Twitter, Linked In and Foursquare) in two ways. First, from Socially's UI, the user is able to *manually* open the Facebook News Feed by starting Socially and opening Facebook News Feed. Second, Socially pushes recent News Feed updates automatically to the user's phone's desktop as

notifications. In addition, Socially has other features, including notifications during incoming calls, caller location, and synchronizing Facebook profile photos and birthdays with the phone. The user is also able to write status updates.

Analyzing the automation design of the news feed notifications, at the *acquire* stage Socially senses across the user's SNS on new status updates. This sensing is fully automated and happens in the background (automation level 10). Then the system *analyzes* the acquired data and *decides* about what SNS updates to push to the user. This is also done fully automatically, without informing the user (level 10). After that, it *implements* the notification. This implementation happens beyond the user's control. The user is informed about a new notification with an alarm, and the new SNS updates are shown on the phone's desktop (level 7).

4.3 Collaborative Automatic Mobile Video Production I (Publication III)

In Publication III, the authors concentrated on studying automation in the context of collaborative video remixing. The focus of the study was on human–computer collaboration in the production of video remixes from mobile video clips taken by the audience during a music concert. This was an interesting context since nowadays recording mobile video clips in music concerts and publishing them in social networking services is popular. The authors did a case study in the field using an automatic video remixing system (AVRS) prototype, which uses a pool of individual video clips and stitches them together as a video compilation. A key issue with designing such a system is the level at which the editing task should be automated and thus allocated between human and computer.

The authors approached the problem by studying the motivations and needs for collaborative video compilations and the role of automation in the process of editing the compilations. The focus was on how the main stakeholders of a live music event, the artist and the fans, experience the products and the process of remixing audience-recorded mobile video, both manually and automatically. The study focused on three research questions: (1) What are the users' motivations for collaborative video compilations? (2) How do users react to manual video remixing? and (3) How do users react to automatic video remixing? At the time of the study, there was a somewhat large body of related research in HCI on video editing (Kirk et al. 2007), multi-camera video production (Engström et al. 2008), music videos (Foote et al. 2002), automation (Shamma et al. 2007), and live contexts (Kennedy & Naaman 2009). However, none of the earlier studies had combined those aspects in a real-world case study.

As a case study, the authors arranged a live rock concert in collaboration with a popular Finnish rock band and their record company. Eleven fans of the band were recruited to attend the

concert and to take mobile video clips there. Also a pre-field trial focus group session was conducted to discover opinions, reactions, and experiences on social video production from live music concerts. Data from the field trial were collected through individual interviews.

The results revealed that automation-related design decisions have several implications for the motivations and reactions the users have toward a collaborative mobile video remixing system and the actual video compilations. For example, the authors found that there was a strong interconnection between the filming process and the editing process. Before the filming stage, some of the participants had made assumptions about how the automatic remixer would work and directed their filming based on those assumptions. Thus, assumptions about the logic of the automatic editing process affected the participants' filming process.

4.3.1 Automatic Video Remixing System – System Description and Automation Design

The Nokia's AVRS utilizes context-awareness data from multiple sensors, such as a compass, a GPS, and an accelerometer. The data obtained from the sensors are stored as time-stamped metadata, while a user is recording video. The data from multiple video clips are then used for determining interesting occurrences, perspectives, and high-quality media segments, which are then included in the video remix. The approach reminds crowdsourcing. A collaborative pool of video clips is gathered, and, based on the recorded context data of individual clips, interesting events are determined.

Using Parasuraman et al.'s (2000) levels and types of automation, at the *acquire* stage AVRS senses context data and adds the data to a video clip. This is done during the filming process and is fully automatic without user control (level 10). At the *analysis* stage, without user control, the system goes through the context data from the pool of the individual clips and *decides* what to include in the remix (level 10). After that, in the *implementation* stage, the selected parts of the clips are combined. In the eyes of the user, the process was fully automatic and the user who recorded video clips had no direct control over the process. However, before transferring clips to the remixer database (before the analysis stage), users were able to exclude their own individual clips from being used, if they wanted.

4.4 Collaborative Automatic Mobile Video Production II (Publication IV)

In Publication IV, the authors continued studying automation in collaborative video remixing. Although in Publication III the authors showed that automatic editing can ease the burden of remixing, the problem is that the users must also be willing to hand over their personally-recorded footage to the automatic system. The authors focused on three questions: (1) How useful do the people that have attended a live music event perceive the automatic collaborative video remixes as memorabilia? (2) How much control do people desire when contributing personal video content to be remixed by an automatic video remixing system? and (3) What are peoples' attitudes about being publicly acknowledged if their clips were used in the published remix?

Also in this study, a field trial was arranged. For the field trial, the authors used the same AVRS prototype as in Publication III, but with some tweaks in the remixing algorithm. The authors arranged a two-day field trial at Provinssirock Music Festival in Finland during summer 2010. The authors collaborated with two of the performing rock bands and recruited 51 festival attendees to take mobile video clips during the bands' concerts. After the festival, all the video clips were used as material for video remixes produced by the automatic video remixer system, and they were also handed to the participants to be manually remixed with a web-based video editor called Jaycut. After the remixes were ready, they were published on YouTube for the participants to view. A web-based questionnaire containing open-ended and Likert-scale order-ranking questions was used as a data collection method.

The results revealed that people assess automatic video remix memorabilia as fairly equal to amateur-made manual ones, even if the manually-created video remixes are better in overall quality; as a remixing actor, a computer can be perceived to be more trustworthy than a human remixer, and the quality of the video remix and the publication forum of the remix outcome plays a significant role when people are deciding whether or not they need public acknowledgement for their contribution.

4.5 Monitoring System for Mobile Learning (Publication V)

In Publication V, the authors studied the user experience of a mobile learning system in primary school teaching. In this thesis, the results of the study are analyzed from the perspective of the teacher's homework monitoring system, which was a part of the mobile learning system. The authors made an intervention study in the field with a case system that was a convergence of the printed schoolbook, IMediaLink image recognition software by VTT (Technical Research

Centre of Finland), three types of mobile hybrid media exercises, and an automated data log feature that enabled teachers to monitor how pupils perform with the exercises.

In the field trial, a primary school English class (teacher and 25 pupils aged 12) used the system for three weeks. The pupils had six English lessons and used the system as part of the learning material. As data collection methods, individual interviews, pair interviews with pupils, data logs, questionnaires, and personal diaries were used.

Related to automation, the results revealed that during the study the teacher had decided to replace the automatic tracking system by instructing the pupils to send her an SMS after they had done the exercises. This was because that kind of manual homework reporting felt more intimate and supported explicit interaction between the pupil and teacher better than the fully automatic monitoring system did.

4.5.1 Monitoring of Mobile Learning – System Description and Automation Design

Each time a pupil launches one of the exercises with her phone, the monitoring system automatically *senses* that (level 10), *analyzes* and *decides* what data log information to disclose to the teacher (all the logged data in this case), and *implements* the disclosure action (i.e., sending the data to the teacher's web interface). All the stages were fully automated, and neither the pupil nor the teacher had control over the content of the acquired and disclosed data. The acquired data contained time stamps of each pupil's use of the exercises: the number of times an exercise was accessed and the user's result after he or she completed the exercise.

4.6 Privacy in Social Media (Publication VI)

In Publication VI, the authors concentrated on the implications of automatic information disclosure for the user's privacy experience in social media services. First, the authors reviewed empirical evidence from recently published studies to learn about the implications of automation on social interaction. To the authors' knowledge, only individual studies had been published on the matter, and this was the first attempt to synthesize results. The authors revisited three real-world case studies, which concentrated on location sharing (Publication I), sharing of music listening data (Silfverberg et al. 2011), and sharing of digital photographs (Näsänen et al. 2009). The authors aimed to understand the link between automation design and privacy-related concerns in order to inform the design of new features and services with a pleasant UX. Earlier research had established the notions of feedback and control as important concepts in ubicomp-

supported social media (Bellotti & Sellen 1993; Iachello & Hong 2007; Patil & Kobsa 2009). However, because of the immense design spaces of control and feedback, the concepts have remained largely vague. The authors focused on this issue and utilized the levels of automation framework by Parasuraman et al. (2000) to tangibly show up the multiplicity with which functions can be allocated between the user and the social media service.

The findings suggested three categories of privacy concerns people might have with automated features in social media: (1) insensitivity to situational demands (user is unable to control disclosure in specific times or places), (2) inadequate control of nuance and veracity (user is unable to change the details of the disclosed content), and (3) inability to control disclosure with service providers and third parties (user is unable to control or know what exactly the system is tracking and for what purpose).

4.6.1 System Descriptions and Automation Designs

One of the publications in the cross case study was Publication I in this thesis. Therefore one of the systems (location sharing) was Jaiku, which has already been described in section 4.1.1.

The music listening system in Silfverberg et al. (2011) was Last.fm. Last.fm is a social network site that uses the music listening information of its users as the main content for their online profiles. Last.fm discloses information about a user's music listening habits to other Last.fm users. Similarly to Jaiku, the Last.fm disclosure process is heavily automated. At the *acquire* stage, Last.fm detects when a user plays an audio track on a device that is connected to the Internet. This detection happens without the user's control (level 10). When the user plays any audio track on a connected device, Last.fm senses it and *analyzes* the audio ID of the track, compares it to Last.fm's database, and then *decides* (identifies) which name to select for disclosure. Finally, it discloses the name and artist of the song to the user's public profile. As with Jaiku, this implementation occurs beyond the user's control, but the user can see the currently disclosed song information by opening her Last.fm profile page (level 8).

The photo sharing system in Näsänen et al. (2009) was Meaning. Meaning is an automated *photo* uploader that enables publishing, tagging, and automatic metadata enrichment of photos and automatically publishes a just-taken photo in the user's web album. Meaning is the most highly automated of the three. At the *acquire* stage, Meaning is operating in the background, sensing whenever a user takes a photo. When a photo is taken, Meaning immediately *analyzes* and *decides* that the exact photo will be published (level 10) and *implements* its decision without any user control or feedback (level 10) by sending (disclosing) the photo to Meaning's web album server for users to view.

5. Results

This chapter presents the results of the thesis. The results are presented in the light of the two research questions: *RQ1: How can automation support the user experience in context-aware social media?; RQ2:What challenges does the user face with automation in context-aware social media?* Based on the results, implications for design are proposed.

5.1 Structure of the Results

To give the results of the case studies a cross-sectional view, the results are categorized under three themes: automation in input of information, automation in output of information, and automation in collaborative generation of media. Here *input of information* means automated pushing of social information to a user's phone about others, while *output of information* means information disclosure about the user to others. *Collaborative* means use of automation in collaborative social media tasks where users work with each other and with the service. They do not necessarily have a common goal, but each actor's contribution is used for the benefit of the user community. The three themes were decided based on both a bottom-up approach from the publications and on earlier research on human social interaction. Regarding the input and output categories, after Publication I was completed, it became clear that in social media there are two parties in the interaction, sender and recipient, which can experience the same information differently. Therefore, the UX regarding the same information was different. In addition, earlier research in interpersonal communication considered information input and output of information as fundamental parts of all social interaction, meaning that all communication has a sender and a receiver (Fiske et al. 1994). Furthermore, people regulate their interaction with each other by regulating information flow from others (input) and to others (output) (Altman 1975). Regarding the collaboration theme, in Publication I Jaiku, as explained in 4.1.1, had collaborative aspects in generating a location label pool. However, the subjective nature of the user-created location labels in Publication I indicated that using automation in collaborative tasks may not self evidently support the UX. Furthermore, collaboration can be considered as a fundamental part of social media (Kaplan & Healein, 2010).

The themes are not totally separate, and some cases can be viewed from the perspective of more than one theme. This will also give understanding about the user and contextual dependency of the UX, meaning that whether automation affects positively or negatively on UX is dependent not only on the technology studied but also on the users and the use context. To give a theoretical perspective for the use case descriptions, from the automation and control points of view, the studies were revisited and analyzed in line with Parasuraman et al.'s (2000) automation and Averill's (1973) control frameworks. From the UX point of view, the studies were revisited and users' (groups, stakeholders, individuals) motivations and goals for using the studied technologies were analyzed in line with Hassenzahl's (2005) pragmatic and hedonic aspects as well as the do-goal-be-goal model. As the technological systems are already described in earlier chapters, the focus of this chapter is on what kind of experiences the users had with automation in the services in relation to their pragmatic and hedonic goals.

Publications I–VI were grouped under the three themes as follows (Table 5). Automation in information input was studied mainly in Publications I, II, and V. In Publication I, users' real-time locations were shared between each other through Jaiku's mobile location aware service. The input perspective of Publication I concentrates on how automatic location information sharing was experienced from the information receiver's point of view. In Publication II, Facebook's News Feed updates were pushed to user's phones through the Socially mobile service. The input perspective of Publication II concentrates on how automatic notifications about Facebook updates to phones' desktops were perceived by the users. In Publication V, pupils' interaction with mobile learning exercises were automatically tracked and shared with their teacher. The input perspective of Publication V concentrates on how the teacher perceived that information about pupil's homework activity that was automatically input to her desktop computer.

Automation in information output was studied mainly in Publications I, IV, and VI. In Publication I, the output perspective comes from users' experiences on automatic disclosure of their locations to other Jaiku contacts. In Publication IV, the output perspective comes from users' feelings and experiences concerning that their personal video clips would be used as part of multi-camera video remixes, which would then be publicly available in social media (e.g., on YouTube). In addition, related to information output, user's attitudes on disclosing their names as part of published remixes were studied. Publication VI concentrated on privacy from the information disclosure perspective. Therefore, Publication VI concentrated solely on information output.

Automation in collaborative social media tasks was studied mainly in Publications I, III, and IV. In these publications, the studied systems included clear collaborative attributes that were automated on a high level. In Publication I, the collaborative aspect comes from UX with the collaborative creation of a location name pool that was automatically used among the contacts.

In Publication III, the collaborative aspect comes from UX with automatic editing of video remixing using a collaborative pool of personal video clips as material. In Publication IV, the collaborative aspect comes from studying users' experiences on how collaboratively recorded personal video clips can be remixed automatically and how these remixes work as memorabilia from a music event.

	Information input	Information output	Collaboration
Publication I	X	X	X
Publication II	X		
Publication III			X
Publication IV		X	X
Publication V	X		
Publication VI		X	

Table 5. Publications' contribution regarding the three automation perspective themes.

5.2 How Can Automation Support the User Experience in Context-Aware Social Media?

The RQ1 was: *How can automation support the user experience in context-aware social media services?* This was set for studying how allocating social interaction-related information processing tasks to a computer could enhance the service's UX. Automation's UX in the service was understood as how the automation could support the user to achieve her goals. From the input perspective, the results showed that automation could save the user from manually pulling context information and therefore help the user in being better aware of her social surroundings. From the information output perspective, the results showed that automation could help the user from manually updating and managing information in a social media service and therefore facilitate the user's social life. From the cooperation perspective, the results showed that automation could offer a channel to participate and contribute to a social media activity without a requirement for a complete management of the activity.

5.2.1 Automation in Information Input

In Publication I, information about users' contacts' real-time locations was automatically input to a user's smart phone through the Jaiku service. The input of information was highly automatic, and if the user had Jaiku installed on her phone, her contacts' presence and location information would be automatically updated without her having to pull the data in. What the user had to do was open Jaiku's contact list from her phone and check her contacts' current locations.

From the input perspective, one of the three groups (referred to in Publication I as the Students, the Birders, the Hipsters) perceived Jaiku's automatic location input as useful. The Students who found it useful were a group of five men and five women, aged from 18 to 20 years. They explained that the location information of Jaiku was useful and they enjoyed following each other's locations. One reason for their perceiving automatic input as useful was that they shared time together a lot in school and in their free time. As their daily activities were shared, automatic location sharing benefited them by contributing to the coordination of mobility and communication relevant in these activities. The main uses they reported were coordination and having new opportunities for ad hoc encounters.

By applying Hassenzahl's do-goal and be-goal distinction, automation supported their do-goal of getting information about others' current locations. Furthermore, this do-goal was a product of the be-goal of being able to coordinate meetings and having new opportunities for ad-hoc encounters—in other words, to fulfill the basic psychological need of feeling related to others. Therefore, in this case, getting one's friends' location information inputted automatically to a personal phone eased the task of socializing with others and supported the sense of closeness to others; in that way, automation made the UX of the service better.

In Publication II, the study focused on UX with a mobile service that pushed SNS information to phones' desktops as notifications. The users had varying experiences with the service. From the 11 participants in the study, three (the High-users) found automatic push notifications valuable. The participants who perceived that the notifications enhanced the UX of the system were keen on knowing what their Facebook friends were up to. Therefore, their be-goal was to be aware of others' doings as much as possible. To fulfill this be-goal, they needed to get Facebook News Feed updates to read. This was their do-goal, and for this do-goal Socially was able to contribute positively with the notifications. Therefore, automatic input of information enhanced the UX of the service by explicitly supporting users' do-goal and implicitly their be-goal. The High-users (in Publication II the users were categorized as the High-users, the Low-users, and Non-users) were more focused on systematically following others than were the Low-users, who did not perceive notifications useful. In addition, the High-users also explored the control possibilities of automation more than the others. They had set the update interval to less frequent from the default. Therefore, the interruptions the notifications produced were not as frequent and therefore were easier to tolerate. Harnessing the usefulness of automation required not only possibilities for user control, but also that users actually took advantage of the designed control possibilities.

In Publication V, the authors studied a mobile learning system in an elementary school environment. The system included an automatic homework monitoring system. The teacher had access to a web-based interface by means of which she was able to monitor when each pupil had accessed and done the exercises. The automatic input of pupils' homework information

potentially helped the teacher to track who had done his or her homework and when. It also potentially helped the teacher to monitor how well the pupils performed the exercises. The teacher did not use the monitoring system much. This she said was partly because the exercises were not compulsory and did not affect pupils' grades. However, she said that if the exercises were part of the official curriculum, she would have used the system for monitoring more frequently. Thus, the results hinted that an automatic monitoring system could be useful, although the research set-up was not genuine enough to bring that fully out. The results were parallel to the results of Publication II: If there is a strong enough goal to be aware of happenings in social surroundings, automation of information input can enhance the UX of the social media service.

5.2.2 Automation in Information Output

Automation in information output in the social media context may have the advantage of saving a person from manually managing and updating her social media account with new media or information. In Publication I, the group of students found the automatic sharing of location information useful for them. By giving the service the decisional control of disclosing their location, they did not have the burden of manually updating the information all the time. In everyday life contexts, a mobile user does not have the time and resources to *manually* post and update her location information all the time. This would also require constant situation awareness in the form of remembering to update every time location changes during the day, which is practically impossible. The users perceived that automation assisted them in their do-goal of updating their current location information. This helped them to be in contact with their friends and in that way promoted their hedonic be-goal of being related to others. Therefore, automation did enhance the UX of the service.

However, the ability to manually name the locations was essential to enhance the communicativeness of location names. For example, there were a few cases where a location label made visible the event in which the user was participating. For example, during the study most of the students were taking a course together and one of them had named the location of the place as [teacher of the course]. Another example was a location label that referred to a name of an office building. This was changed to a name of a pub in that office building. For this user group, the name of the pub told more about the context of the person than the name of the building did. The importance of manual control will be discussed more in later chapters.

In Publication IV, users' personal video clips were used as material for video remixes. From the perspective of automatic information output, the users handed over decisional control to the service on the other kinds of video material with which their personal video clips were remixed

and published as part of the video remixing process. Thus, as in Publication I, decisional control over using and publishing personal content was handed over to a service. However, the media and the context were different. In the study, users were asked how they perceived an automatic video remixing service compared to human peers whom they did not know personally. The findings showed that the users trusted the automatic remixing service more than they trusted an unknown peer. The authors believed that the results indicated that the automatic remixing system was seen as trustworthy with regard to sharing one's personal video clips to be used in creating a public video remix. The participants might have felt that the risk involved in their clips being used in an unpleasant way was greater with an unknown peer being the remixer than with the automatic remixing engine. They might have considered the automatic system as somewhat "deterministic" and therefore trusted that the automatic system was incapable of using the material in a way that would violate their self-presentation goals. From the goal perspective, the users' do-goal was to bring out a collaboratively generated video remix, which the people who had attended the same event could use to remember the event. Therefore, they had a hedonic goal that Hassenzahl and Tractinsky (2006) would call an evocative facet of the UX, as the goal was to provoke memories. Thus, as in Publication I, the results showed that automating information output in social media contexts can be valuable for the user and enhance the UX of the service. However, it requires that users trust that the system does not violate their self-presentation goals.

5.2.3 Automation in Collaborative Generation of Media

From the perspective of collaboratively generated media, automation may potentially enable an easy use of other users' content and that way ease the burned of generating and sharing media. In Publication I, the users accumulated a collaborative pool of location labels as part of using Jaiku. In Jaiku, when the user manually writes a location name, the name will be saved in a collaborative location label database and used automatically as the user's contacts' location label if they are in that location. In other words, when Jaiku senses that user is in a new location, it analyzes the location name database and if it finds a matching location label from the collaborative database, it assigns that location name to the user. Therefore, the more the users name their locations, the more comprehensive the location label pool becomes. Also, if the user did not like the assigned location name, she was able to overwrite it. Automatically assigning one's location with a location name that was written by someone else had potential in easing the burden of communicating one's location to others and therefore enhancing the service's UX by contributing to the user's be-goal and the need of being socially connected to her contacts.

The collaborative aspect of generating a location label pool worked quite well in the group of students. They hardly ever overrode the automatic locations written by others, except for a few

occasions, often for the reason of increasing informativeness of the location name. It seemed that the collaborative pool of labels was useful for the students because they knew each other quite well and interacted with each other frequently. They also had specific places known to everyone in the group, which probably affected the fact that the labels written by the other members of the group were often perceived as adequate and not overwritten often. Therefore, automating the collaborative generation and use of media did support the UX of the service.

In Publications III and IV, automation was in two roles considering collaborative generation of media. First, it was a technological remixer system that made a video compilation out of a pool of video clips taken by individual users. Second, on a larger scale the video remix production was partly automated from the user's (an amateur cameraman's) point of view. While the users manually recorded the clips, they handed over the decisional control on how to use their clips to other stakeholders. Thus, from the user's perspective, the other stakeholders and actors: the artist, the service provider, and the automatic remixing system were much like a black box. In Publication III the focus was more on the actual workings of the automatic video remixer, and in the Publication IV the focus was also on what kind of decisional control people needed over their clips when handing them over to be remixed and published by other actors.

Based on the results of Publication III, automation-related design decisions had several implications on the motivations and reactions the users had toward the collaborative mobile video remixing system and the actual video compilations. Based on the results, automation can support the UX of the service by easing the burden of remix production. The results showed that manually going through the raw material from a pool of collaboratively shot multi-camera video clips can quickly become cumbersome. This came up when only one of the eight fans who were participating in the study actually made a manual video remix, regardless of the fact that many of them intended to make one, but never actually got into it. Therefore, many of the participants had a goal of doing a remix. The motivation that the authors gave to the users was that each remix would be reviewed by the band, and if they gave it good enough reviews it would be published on the band's web site. Considering that all the participants were fans of the band, they certainly had a hedonic motivation to get social glory by being connected to the band publicly. However, most of the participants said that they either did not have time for it, or they felt it was too much of a burden to start figuring out how the editor worked and going through the raw material. Also, some had technical difficulties in getting their computers to view the material and upload the best videos to the web-based editor. The result was that the do-goal was just overwhelming for most. Thus, automation of remixing offered people a channel to participate and contribute to an activity without a requirement for understanding and handling the complexity of the activity itself. Automation enabled users to experience participation. Therefore, by automating the remixing process to the point where humans did not have to do anything but film the raw material during the concert, the UX was clearly enhanced. The laborious struggle with the

technology and the burden of perusing the overwhelming quantity of material disappeared. However, as will be discussed later, how useful the automatic remixes actually are is dependent on the intended use of the remix.

In Publication III, another finding supporting the use of automation in collaborative media generation was that the automatic video remixes were not assessed using the same criteria applied to human-made ones. When the fans watched the compilations, they first described them as passive and uninteresting. However, after they were told that the compilations were automatically edited, most of them then developed a different perspective. Even though they lacked the human touch, they were still viewed positively. It seemed that people did not have such high expectations for the machine-made compilations.

Interestingly, parallel results were found in Publication IV, where the results indicated that, although the automatic remixes were not perceived to be as good as the best human-made ones in overall quality, they were still perceived to be as good as the human-made ones from memorabilia perspective. This result argues that a video compilation does not have to be excellent in artistic quality in order to trigger memories from the actual event and therefore be useful. Thus, referring to the hedonic UX category of provoking memories (Hassenzahl & Tractinsky 2006), automation was able to enhance UX—in this case, even the UX of the actual concert event. It also came up that participants thought that an automatic remix would be great to have on a mobile phone right after the concert as a piece of memorabilia to show to friends. Thus, automation could support the UX of the remixing process and the event by producing the compilation much faster than a human editor could. This would extend the timeline of the concert experience and would be perceived as valuable even if it were not top-notch quality.

5.2.4 Summary

The results showed that automation is capable of supporting users in pragmatic tasks. In addition, if the automatic execution of the pragmatic tasks is well in line with the user's hedonic goals, automation supports UX with the service. From the input perspective, automation can *save the user from manually fetching* social media content and therefore *assist the user in being better aware of her social surroundings*. From the information output perspective, automation can forward the user's online presence by *facilitating creation and publishing content* in a social media service and therefore facilitate social interaction. From the cooperation perspective, automation can *offer a channel to participate and contribute* to a social media activity without a requirement for understanding and handling the complexity of the activity itself and generating the media all by oneself.

5.3 What Challenges Does a User Face with Automation in Context-Aware Social Media?

The RQ2: *What challenges does a user face with automation in context-aware social media*, was set to guide finding experiences on the costs automation can bring out in connection with UX. This can be considered of utmost importance considering that automation is sometimes implemented just because it is technically possible (Sheridan 2002) and the negative consequences are often understated or not understood. In addition, human factors research on traditional automation has shown that automation has both benefits and costs. All the articles (I–VI) contribute to this research question. Similarly to the RQ1, the RQ2 will be studied in relation to the specific themes: information input, information output, and collaborative social media tasks.

From the information input perspective, the results revealed that the challenges for automation to support UX is that automation can threaten the validity of information, and, if not truly parallel with the user's hedonic goals, the danger is that the interruptions automation creates will generate annoyance. From the information output perspective, the results revealed that if automation is not parallel with the user's hedonic goals, it might lower the UX by threatening the user's privacy. From the cooperation point of view, the results emphasized the importance of user understanding of the logic of automation.

5.3.1 Automation in Information Input

In the earlier section (5.2.1), automation in input of information was found to be able to support the UX of the service. Particularly, automation was able to support the hedonic be-goal of being more aware of one's social surroundings.

As presented in section 5.2.1, in Publication I a group of students perceived automation of information input useful in assisting them to stay connected to their friends. However, the study also found out that users confronted challenges with automation. From the information input perspective, Jaiku was built in a way that when user's contacts' context information was input to the UI, Jaiku did not separate the automatically generated location names from the manually written ones. The danger was that the communicative functions of location labels might be lost. In other words, Jaiku did not inform the user whether her contacts' location information was generated by the contact herself manually, Jaiku automatically, or if the name was selected from the collaborative pool of location names. This made it sometimes difficult for the recipient to interpret the context of the user. This was because users often named their locations based on the context and did not use only geographical location names. Although these manually written

names in many cases enhanced the communicative effect of the location labels, they made it difficult for the recipient to know if the shown location name was a reuse from the location name pool or if the context of the user actually was the one Jaiku showed. Therefore, if the system did not inform the user about the actual source of the information, the recipient could draw inaccurate or wrong conclusions about the sender's state. In that case, it might be that the user would not be given the real information and could even be misled about the contact's real state. With this kind of negative experience, automation can actually lower the UX of the system because of its inability to inform the user correctly.

The findings of Publication II showed that automation of information input in the social media context is not all about efficiency and productivity. The results showed that being aware of happenings in social media is not always the topmost motivation for reading social media. Many users read Facebook as a time-filling activity or to relax. Therefore, because information input (notifications) was strongly automated, to the point where the service decided when and what kind of information to push to the users's phone's desktop and also notified the user about the new updates with an alarm, it was not in line with the user's hedonic be-goal of being relaxed. In this case, the user might perceive that her decisional control on when to read Facebook is too limited and might not feel that automation is supporting her hedonic goals. Such users became annoyed while interacting with the system. It was also found that reading the updates manually made the information feel more meaningful. Lack of perceived control has also been shown to lower the depth of interaction with the service (Novak et al. 2000). It was clear that for users whose be-goal was to relax by reading Facebook, the added decisional control brought by manual reading made their UX much better than it was with automatic push notifications.

In the mobile learning context, in Publication V, the teacher had access to a web-based interface by means of which she was able to monitor when each pupil had accessed and completed the exercises. The constraint automation faced in supporting the UX was that the information it generated and mediated was considered too generic and lacked an intimate interaction with the pupils. The teacher also did not think it was "necessary" to use the monitoring system in this case, because it was a study and the exercises were "kind of extra work." She used it only a few times. The system assisted a teacher in a do-goal of finding out if the pupils had done their homework and how they performed. However, in addition to being aware of pupils' homework activities, the teacher's be-goal was to be connected to pupils socially. In this case, being aware about homework performance was not that important compared to having a social interaction with the pupils. Although she did not explicitly say, she might have also felt that she was somehow spying on pupils' doings by monitoring their phone activities. Similar kinds of lurking feelings have been reported by Raento and Oulasvirta (2008). However, instead of monitoring the pupils, the teacher had instructed the pupils to send text

messages to her when they had done their homework. This, she said, was an explicit way to communicate with the children outside the school. Therefore, the manual reporting by SMS worked better than the automatic monitoring interface, and there was a new kind of explicit interaction between the pupils and the teacher. This, the teacher thought, brought one-to-one interaction that is hard to achieve in a classroom full of pupils. In this case, her be-goals guided her into using the more intimate way instead of the precise and efficient way.

5.3.2 Automation in Information Output

From the perspective of information output, in Publication I the challenges that users faced with automation were, at the level of a group, neglect in the face of useless automation and withdrawal in the face of a too-strong model of automation. Two out of the three groups thought that the automated features did not impact on their daily life at all. The exception was the students, whose experiences were discussed in section 5.1.

Useless automation came up with the second user group, the Birders. The Birders were a group of birdwatchers, and almost all communications within the group were about bird watching. Their do-goal regarding communication with each other was to share information about bird sightings. The Birders' view on Jaiku's location automation was best described as indifference or neglect. The disclosure of movements in real time was not interesting to them. The Birders did not have any shared activities outside bird watching, and even that was not an activity done together. Therefore, they did not have the goal of being socially connected to each other more deeply that they already were through one-to-one SMS or phone calls. For their do-goal of knowing about bird sightings, they had a dedicated SMS-based service. They found little use for the automatic disclosure, but they did not have any privacy concerns either. This was probably because they did not have close ties, and there was little risk in accidentally disclosing personal information. In a nutshell, the Birders were so distant that it did not matter if the rest of the user group knew their locations and could follow them.

Withdrawal of using Jaiku in the face of a too-threateningly high level of location disclosure automation came up with the Hipsters. The Hipsters were a group of four men and four women, in their 30s who were living in the San Francisco Bay Area, California. Although the Hipsters were friends and spent time together, they found hardly any use for the automated location information in Jaiku. Although their be-goal was to be socially connected with each other, the majority of Hipsters had a negative first impression about the concept of Jaiku, and one reaction was: "I can't lie anymore." Therefore, although automation potentially assisted in telling users' whereabouts to others, and that way it had a potential in enhancing the UX of Jaiku (like with the group of students in section 5.1), the automatic location disclosure conflicted with the group's

structure of privacy. The users perceived that automation took away too much of their decisional control over disclosing one's whereabouts. Because many of the users were not logged in all the time, the automatic location disclosure had little value and could not be used reliably. Thus, the negative impacts that were predicted did not realize among Hipsters because they simply neglected to use the system or switched it off.

The negative effects of automation on the individual reflected the classic findings of human factors research. Jaiku's pragmatic, do-goal-related automated features on information output were often problematic to the users, which affected negatively the pragmatic level of the UX. Particularly, the workings of location automation in Jaiku were not obvious to the users. This was due to the multiple hidden layers of processing that affected a perceivable outcome. Users had problems in understanding the logic, timeliness, and accuracy of automatic location data, and because of that some of the participants were struggling to see the purpose of Jaiku. Users mainly problematized the logic of automation when, in consequence of automation, they were not able to achieve their communicative and social ends (i.e., hedonic be-goals). In other words, they did not explore the logic, out of pure curiosity or as part of familiarizing themselves with the system. Similar results on lack of spontaneously exploring the logic of automation were reported also with the notifications in Publication II (section 5.1.1).

The results of Publication III brought up the importance of manual control in achieving hedonic UX goals. Manual control of video remixing stimulated the user's personal development. The user, who edited video remixes manually, felt that by controlling the editing process herself she was able to express herself like she wanted. The editing process was very challenging for her, but by overcoming the challenge she gained personal development and was very proud of her work. Manual control gave her also the possibility for a high level of self presentation, which was not possible through automatically generated remixes.

In Publication IV, automatic information output was studied from the control and impression management point of views. User perceptions were studied concerning an automatic public acknowledgment in a case where the user had handed personal video clips over as material for a public remix. The results indicated that because the users were uncertain about the outcome, they wanted to review the remix before deciding about the acknowledgment. This was a challenge for an automated remixing service in a way that a human intervention was required before publishing the remix. Only a few participants expressed an unconditional desire for acknowledgment or publicity. Those who expressed a conditional need for acknowledgement wanted to provide their consent only after evaluating their own or the final content. There were several reasons for not wishing an acknowledgment, such as professional reasons (one did not want his name to exist on the Internet). Also, some were skeptical about the quality of the recording, their own skills, or the quality of the final remix. People did not want to take their chances about being associated with suspicious content or forums. The willingness to share was

largely dependent on the quality and subjective meaningfulness of the remix as well as the reputation of the venue where the remix would be published. The results indicated that people want to be aware of how they are presented as part of the outcome and want decisional control on it in such a way that matches their impression management goals. Therefore, although automatically giving public acknowledgment about contribution might sound like a good idea to support the hedonic level of UX, it is not that simple. People can have varying hedonic goals concerning self presentation in social media services. One might want to be famous, whereas the other might want to keep a low profile.

In Publication I, one of the main negative UX results of automation in information output was that some users felt they had to compromise their privacy too much. In Publication IV, privacy became relevant through user's needs to have decisional control related to their impression management. As a result of these findings, in Publication VI the authors studied privacy in automatic information output more systematically. The authors found three categories of privacy concerns in present-day social media that bring up the user need for controlling information output: (1) insensitivity to situational demands, (2) inadequate control of nuance and veracity, and (3) inability to control disclosure with service providers and third parties. By "insensitivity to situational demands," the authors mean the user's inability to control disclosure situationally in accordance with requirements posed by specific times or places. This came up often in contexts where the receiver was familiar enough with the user to aggregate the disclosed information with other things that the receiver knew about the user. Thus, the disclosed information often told friends and family more about the user than the disclosed content alone could reveal. By "inadequate control of nuance and veracity," the authors mean users' inability to modify the specifics of the disclosed content. Users may not have the option of disclosing less-specific information about their state of affairs or even adding to the content so that they can explain the context of their behavior. By "inability to control disclosure with service providers and third parties," the authors mean that the user perceives that she is out of control and uninformed about what information the systems are acquiring, how the service providers are analyzing the information, and for what purposes they are disclosing the information. In summary, the three privacy concern categories showed that automation, which aims to create satisfying, "effortless" social interactions, introduces novel problems for users' interactional boundary regulation. Because of the dynamic and context-dependent nature of privacy, it might be challenging to use automatic information output to support the hedonic goals users have regarding social media. Therefore, by lowering user's control over social interaction, automation may affect UX negatively. Using Averill's control categories, especially the user's loss of decisional control over information output brings up privacy concerns, when the user cannot control information output situationally or control the nuance and veracity of disclosed information. However, the user might be able to generate other control mechanisms outside the

automated task. For example, the user might be able to change her behavior (behavioral control) in such a way that her self-presentation goals will not get compromised. However, this requires that the user is aware of how the technology works and is aware of the situation where she should practice behavior control. Perceived behavioral control might be compromised if the user perceives that she cannot be aware of what information the service acquires, how it is analyzed, what and when it discloses the information, and who has access to disclosed information. In that case, it is hard for the user to manage her privacy by changing her behavior, and it is hard to be prepared for the consequences that using the service might have for her self presentation.

5.3.3 Automation in Collaborative Generation of Media

As the results of section 5.2.3 revealed, from the perspective of collaboratively generated media, automation may offer a channel to participate and contribute to an activity without a requirement for understanding and handling the complexity of the activity itself and without the burden of being responsible for the whole activity.

In Publication I, as it was brought up in section 5.2.3, manual writing of location names expanded the collaborative pool of location names that the system automatically uses among the user's contacts. However, as previous sections have explained, the workings of location automation in Publication I were not obvious to the users, simply because of the multiple hidden layers of processing that affected a perceivable outcome. The question of users' understanding is a classic human factors topic. From the collaborative media generation point of view, the problem arose when Jaiku used the users' collaborative location label pool automatically without informing the sender or the recipient. It was hard to know whether the location name assigned to the user was generated by the user, by some of her Jaiku contacts, or by Jaiku's general location label database. This made users puzzle over the workings of Jaiku and also affected the communicativeness of the location names. After all, on many occasions users named locations with names that referred to more than just a geographical location—for example, "home" or the name of a cafeteria. Jaiku did not make transparent its logic of collaborative location diffusion, and it was very hard for the user to figure out the diffusion logic herself.

As discussed earlier, in collaborative video remixing automation can support UX, for example by easing the burden of video editing. Although automatic remixes might not have the artistic quality that human-made ones have, they can still be considered valuable as memorabilia. However, examining more deeply the costs of automation and the challenges users face with automation, several challenges came up: the effect of understanding the logic of automation, unexpected uses of the raw material in manual remixing, and heterogeneous interests of the stakeholders. In the trial, the participants were not told how the automatic editor made decisions

and what information it used in the editing process. This enabled the authors to study the effect of understanding the logic of the automatic editor, especially how the ignorance of the logic of how the automatic remixer used the collaborative pool of video clips affects how the fans filmed in the concert situation. The results revealed that before the filming stage, some of the participants had made assumptions about how the automatic remixer would work and directed their filming based on those assumptions. Some of the participants assumed that the AVRS could not cut the raw clips in any way. Due to this false mental model, they tried to shoot short, ready-to-use clips. This assumed requirement was perceived as irritating by the participants. The participants were thinking about the editing phase in advance while taking video. They tried to collaborate with the automatic editor by pre-planning what kind of material would be useful. Thus, results suggested a strong interconnection between the filming process and the automatic editing process. It came up that transparency and communication between the processes affects the result of automatic remixing.

Other challenges that came up in Publication III were related to the AVRS's abilities to produce artistic compilations. First, it can be challenging for an automatic system to use the raw material as innovatively as a human could. Manual video editing brought up some unexpected uses of the raw material, like innovative use of lights, jumping audio track, and ruined video material, that can be difficult for computers to imitate. The challenge related to the heterogeneous interests of the stakeholders was related to a required artistic quality of the video compilations. As brought up in section 5.1.3, among the fans, even though the automatic compilatios lacked the human touch, they were still viewed positively. It seemed that people did not have such high expectations for the machine-made compilations. However, the artists, whose motivations were in using video compilations as promotional material, saw limitations. They thought that the images the automatic compilations projected about the atmosphere of the live show was so irrational that if they were the only reference to the band's live performance, the fans would not come to watch. They often mentioned the need for human intervention as a part of the automatic editing process. The artists' impression management goals were compromised due to their inability to control the outcome of the remix.

5.3.4 Summary

From the information input perspective, the results revealed that one of the challenges for automation to support UX is that automation can *threaten the validity of information*. If automated data is mixed with manual data in the UI, and the user is not offered a proper feedback about that, the danger is that the communicativeness of information will be lost. In addition, if the information input generates a too-severe interruption compared to the benefit and

does not support the user's hedonic goals, the danger is that automation *generates annoyance* and lowers the UX. From the information output perspective, the results revealed that if automation is not parallel with the user's hedonic goals, it might lower the UX by *threatening the user's privacy* from three perspectives: (1) insensitivity to situational demands, (2) inadequate control of nuance and veracity, and (3) inability to control disclosure with service providers and third parties. From the collaborative point of view, the results revealed that in collaborative media generation, user *understanding of the logic of how automation manages users' media* plays a significant role for the service's UX. If a user is unaware of this logic, the benefits of automation may be lost because of her inability to collaborate with automation and other users in a useful manner.

6. Design Implications for Achieving Good UX with Automation in Social Media

When designers and developers create new social media services, they do have the option to decide on the level of automation. This thesis proposes that designers would study and understand users' pragmatic and hedonic goals in social media use and systematically consider alternative levels of automation for supporting those goals. In addition, especially as the focus of the thesis is in context-aware technology, the understanding of context, where the technology is used, is of utmost importance. Designers need to understand the relevant aspects of the context that the technology needs to sense in order to have abilities to act in a way that the user's goals, practices, and concerns are considered and supported. Furthermore, the thesis proposes that designers would think through what kind of UX supporting implications and what kind of negative UX implications automating a specific task might have for specific user groups. The levels of automation framework (Parasuraman et al. 2000) is a useful framework that guides designers to consider what is done at the different stages of automation: action implementation, decision selection, information analysis, and data acquisition. However, in the social media context the interaction is inherently between humans and not only between human and computer. This suggests that there are other social interaction control mechanisms than what the technology provides (Figure 2).

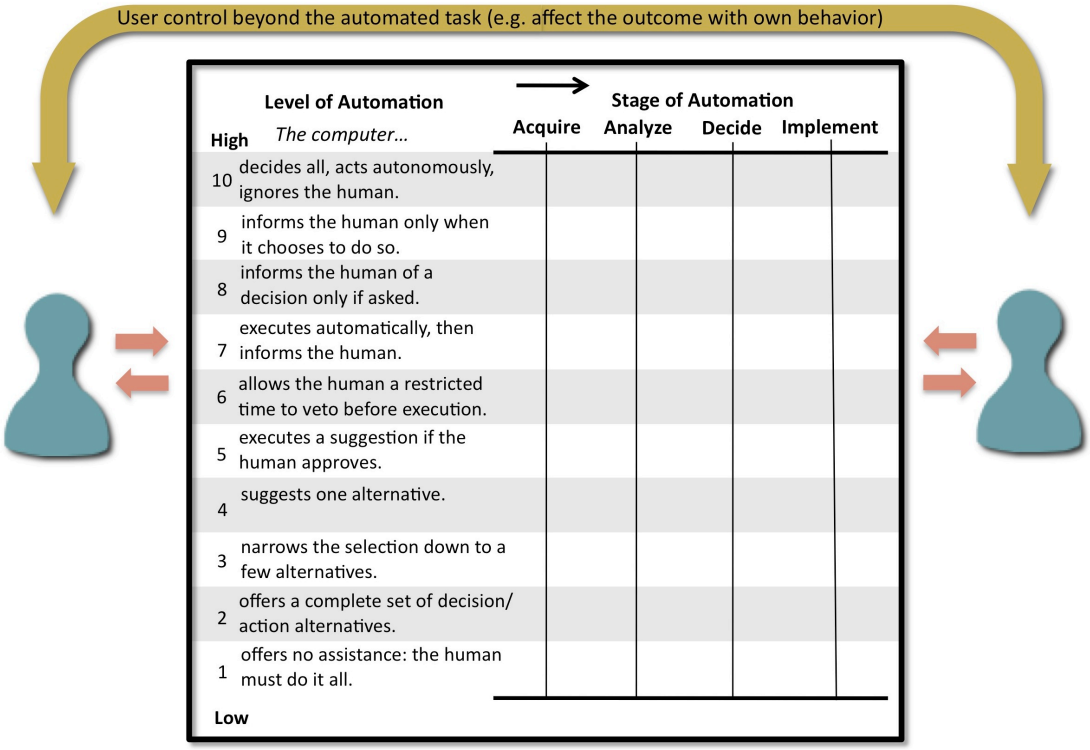

Figure 2. Computer-mediated communication, including the levels and stages of automation according to Parasuraman et al. (2000) and regulation of social interaction beyond the automated task (Vihavainen et al. in press [Publication VI]).

The results presented in this thesis show that automation in context-aware social media can support UX of the service. The results also presented what kind of challenges users might face with automation. Although the results are from individual cases and cannot be generalized to consider all social media, a number of central themes and implications for design arose. First, social constructions and personal motivations affect the UX of automation. Second, efficiency in producing social media does not guarantee that automation supports service UX. Third, increased automation may bring out privacy concerns, which lower the UX. Fourth, the possibility for manual intervention can support the UX. Fifth, inability to understand the logic of automation may lower control over social situations. The design implications are general principles and higher-level issues, which the designer cannot directly affect but should understand and take into account by selecting a proper level of automation. This thesis wants to emphasize that the selection between user control and automation is a trade-off. Too-low automation might bring up new challenges related to usability. Inappropriate levels might also conflict with the social norms of the user community.

6.1.1 Social Constructions and Personal Motivations Affect the User Experience of Automation

Whether automation supports the UX or not in social media is dependent on the social group within which the services are used and on the user's personal motivations. In Publication I, the nature of shared activities and the usefulness of the automated information in Jaiku affected whether automation was perceived as useful, useless, or annoying. The level of automation and its content should be chosen according to what is known about these activities. In Publication II, although both types of users, the ones who liked and the ones who did not like the automated input of information (notifications), had hedonic reasons for using Facebook, those reasons differed crucially. For those who liked the notifications, the be-goal was to be aware of other's doings. However, for those who did not like the notifications, the main be-goal was to relax and fill time. For them, being aware of others' doings was not crucial enough that they would have given up decisional control over when to read Facebook. In Publications III and IV, with the AVRS different stakeholders' heterogeneous motivations and requirements for creating a collaborative video compilation came up. The artists thought that video compilations should be a way to promote the band image and could be used by venue owners to publicize the band. The main motivation was to demonstrate the interaction between the band and the audience to other people who did not see the event live. The fans, on the other hand, were pleased even with less artistic complilations, as they wanted them as memorabilia—for example, to have on their mobile phones right after the concert. In Publication IV, only some of the participants were willing to be automatically acknowledged if their clips were used in a public video compilation. Also, for man,y getting acknowledgment was conditional. All this highlights the dynamic, context-dependent, and subjective nature of the UX presented by Law et al. (2009).

In a nutshell, if automation matches well enough to the user's pragmatic and hedonic goals, it can enhance the UX. Social media are used topresent identities, have conversations, share content, build relationships, build reputations, and disclose presence (Kaplan and Healein, 2010; Kietzmann et al. 2011). These motivations are mainly hedonic motivations and also are related to basic human needs. Therefore, to have automation that supports the UX in social media services, hedonic goals should be in the focus. For this, there are mainly three design approach alternatives, which by no means are exclusionary: first, to learn and know the users' habits and underlying motivations and design automation to answer those; second, to develop automation to learn the users' habits and motivations and automatically adapt to them; and third, to include adequate means for user control so that the user herself is able to set up the service's automated features to match her pragmatic and hedonic goals. Thus, the automation should be flexible enough so it is able to support people with varying motivations and use habits.

The first approach requires deep qualitative knowledge on users' pragmatic and hedonic goals in using the service. Kuniavsky (2010) stated that, if a service is designed to be rigid, the design is much more critical since the possibilities to adjust the service's functions are more limited. A restriction is that often it is not possible to please everyone. However, by narrowing the target group, it is possible to focus the service for specific types of use and make the system rigid and therefore also simpler than a system with manual user settings. Also, it might be that the service does not have to please everyone in the target group, either. For example, in its developer's guide, Apple instructs developers to target 80 percent of the users, and forget the rest. It states that if the service is preset so that it is suitable for 80 percent of the users, there is no need to add additional settings for the remaining 20 percent (Apple 2012). The second approach requires adaptive automation. Although there have been tremendous leaps in adaptive automation, machine learning, and analysis of dynamic multidimensional data, developing a machine that can fully learn humans' social interaction-related habit is very challenging. Automation's inability to be intelligent enough has been addressed earlier. Norman (1990) argued that a main reason that automation can cause harm is not the automation itself but that it is not intelligent enough to handle all abnormal conditions. Even now, after decades of research and development in adaptive automation, human operators still seem to be essential for systems with automation (Parasuraman & Wickens 2008). In the third approach, the user is given decisional control over how strongly the tasks are automated. She could use application settings to tweak the service to suit her needs. This can be good for adding perceived control. However, this approach has its trade off. If the control settings become too complex or automation causes interruptions, the user may get confused and annoyed. The user would have to learn how the settings work, which requires effort. It might feel easier for the user that someone else (i.e., the designer) has made decisions for her.

Design implication: Understand that different social groups and users have different pragmatic and hedonic goals for using the service. Consider alternative ways in which automation can assist in achieving those goals.

6.1.2 Increasing Automation Does Not Guarantee Good Social Media User Experience

The common denominator that rose from the results was that increased automation does not necessarily guarantee a good UX, although it might make content creation and mediation more efficient (the ratio of the output to the input of a given system) (Interaction Design Foundation 2013). Often, automation in social media assists the user directly in her pragmatic tasks (do-

goals), such as automatically informing her friends about her whereabouts or automatically pushing notifications about her friends' SNS updates to her phone's desktop. However, being efficient in pragmatic tasks does not necessarily mean that the user's hedonic goals, such as expressing oneself, or getting relaxed, will be fulfilled. Support for pragmatic and hedonic goals is needed for a pleasant UX. Automating a pragmatic task on a wrong level can conflict with hedonic goals. In fact, it can produce unwanted social situations, for which the user might need to make *corrective social actions* outside the automated systems or even offline outside the social media service. In Publication I, too-"efficient" automation brought up privacy concerns among a user group. The level of automation in a location disclosure task made the disclosure too efficient to support users' social interaction needs. In Publication II, the problem was that automation was too straightforwardly designed to make social interaction more efficient by supporting the always-on culture, but it failed to support most of the people's hedonic goal of getting relaxed with Facebook. Although automatic push notifications made following the Facebook News Feed effortless, for many participants it was too intrusive. Also several participants reported that reading the updates manually made the information feel more meaningful. In Publication III, the AVRS made the production of video compilation practically effortless for the users. However, the quality of the compilation did not reach the level that especially the artists would have wanted. Their be-goal was to build the band's image, which required that the band would be presented on social media in a more artistic way than the automatic remixer was capable of doing. Also, too-strongly implemented automation did not give users a chance for the self expression they would have wanted and that the manual remixing process made possible. In Publication V, although the automatic monitoring system made the monitoring of pupils' homework very efficient for the teacher, it lacked the level of social interaction that was required between the teacher and the pupils. Finally, Publication VI presented that a too-strong automation level that aimed to make social interaction "effortless" might conflict with the user's hedonic goals and bring up privacy concerns.

Therefore, it is not enough that the designers concentrate on how to use automation to assist users in their pragmatic tasks, but automation also has to support hedonic goals. These findings confirm the findings and earlier UX research. For example, Kuniavsky (2010) mentioned the need for more than efficiency in his definition of user experience:

> the totality of end-users' perceptions as they interact with a product or service. These perceptions include effectiveness (how good is the result?), efficiency (how fast or cheap is it?), emotional satisfaction (how good does it feel?), and the quality of the relationship with the entity that created the product or service (what expectations does it create for subsequent interactions?). (p. 14)

On the other hand, it has been shown that people are able to differentiate pragmatic and hedonic attributes (Hassenzahl et al. 2000; Hassenzahl 2004). Hassenzahl (2007) argued that "people may

perceive products as primarily hedonic (a be-product), primarily pragmatic (a do-product), both or even neither" (p. 10). This means that the importance of hedonic and pragmatic aspects may vary depending on context (ibid.) The results indicate that in social media the hedonic qualities are especially important. Many of the results showed that if automation does not support users' be-goals, they always have the option not to use the service (which they did in many cases). In social media, hedonic goals (e.g., self expression, interaction with relevant others) are often the main reasons people use those services.

Design implication: Set the level of automation in pragmatic tasks so that it also supports hedonic social interaction goals, even if it means making the pragmatic tasks more inefficient (by decreasing automation).

6.1.3 High-Level Automation May Produce Privacy Concerns

Privacy concerns are often felt but do not necessary actualize due to the measures the users can take both inside and outside the system. However, although they would not actualize, privacy concerns may still lower the perceived control and lower UX. As Altman's (1975) conceptualization defines privacy as "selective control of access to the self or to one's group" (p. 18), it explicitly states that the user needs to have control over information access to the self. In social media, where self-presentation is a key part, if the user's perceived control over self-presentation is endangered, privacy concerns may evolve. This happens if the user believes she is not able to produce the outcome she desires or to prevent undesired ones, concerning the impressions other people form of her. Again, successful self-presentation is a key part of a pleasant UX in social media. Losing control over self-presentation and therefore over privacy may lower the UX of the service. In Publication I, many participants of the Hipster group had concerns about privacy, saying that it felt "creepy" that Jaiku automatically tracked them. The automatic location disclosure conflicted with the group's structure of privacy, and they were not used to knowing about each other in real time on a daily basis. In Publication IV, the AVRS was considered trustworthier than an unknown peer. However, people still felt they needed to be in control over whether or not their names would be mentioned as part of a public remix. People wanted to be aware of how they were presented as part of a public video remix and wanted to control it in such a way that it matched their impression management goals. In Publication VI, the focus was especially the privacy concerns automatic information disclosure might bring out in the social media context. Based on the results, the automation that should make social interaction more effortless may make it more burdensome due to privacy consequences where the user is unable to regulate interaction with others in a meaningful way. The results showed

that automated information output might raise privacy concerns among the users. In addition, privacy can be understood not only as a possibility for the individual to control what other people know about him or her (output of information), but also the individual's ability to control the information flow about others to him or her (input of information) (Altman 1975). In Publication II, Socially informing users about Facebook News Feed updates was considered an invasion of privacy by some participants. The participant's privacy was violated when she was not able to sufficiently control getting a notification at 9 a.m. on Sunday morning about some half-acquaintance linking a YouTube video to Facebook. Her strategy to control her privacy was to shut off the notifications feature completely.

Privacy sets a trade off for automation. The more features are automated, the more pervasive the service gets. This means that the user has less control over privacy inside the system, which may produce privacy concerns. This forces users to practice control outside the automated system by changing their behavior, adjusting the system (e.g., turning it off), and generating auxiliary social mechanisms to optimize the level of privacy.

Design implication: Understand what kind of privacy concerns the increased automation might bring to the user. Consider alternative levels of automation in each information processing stage and provide the user opportunities for privacy management outside the automated task.

6.1.4 Possibility for Manual Intervention Can Support User Experience

This thesis shows that automatic information might feel too generic and be without holistic or deep enough communicativeness. Or it might be incorrect or too truthful. The reasons people use social media services—present their identities, have conversations with each other, share content, reveal their presence, build relationships, build reputations, and form communities (Kietzmann et al. 2011)—often require that the information they share with each other is highly subjective, context-dependent, and might contain other meanings than the raw information itself. Like Goffman's (1956) concept of self-presentation states, in any social interaction people want to control the impressions other people form of them. Automation by nature lowers control. Therefore, in a social media service it might be that automation limits control of self-presentation. Automation might not be capable of presenting the user to other people as the user would like to. For example, in Publication I, users often named locations with more specific labels than Jaiku was able to support. Perhaps unsatisfied with the communicativeness of automatic labels, the users manually overrode the automatic ones with quite specific and

subjective locations (e.g., “home,” “café,” “library”). Users also wrote labels that referred to something more meaningful than geographical areas. Thus, if a system contains high automation, there should be also a possibility to override the automatic content. In Publication II, the importance of manual control came up from the information input perspective, as several participants reported that reading the updates manually made the information feel more meaningful for them. Manually pulling the news feed information to the phone gave users full control over when to interact with Facebook. This result relates to Novak et al.’s (2000) study on the use of e-commerce websites, where the authors found that perceived control has a major role in determining the flow experience with the system, which again affects the depth of interaction. Also in Publication II, only a couple of users explored the control settings to adjust the news feed update’s time interval for notifications. Most of them did not explore the possibilities but turned the system off if the default setting was not suitable to support their behavior goals. A simple adaptive automation, which would have noticed if the user often skipped the new push notification, and based on that suggested an alternative, less frequent, update time interval, might have supported the UX and kept people using the notifications. In Publication III, the users often mentioned the need for human intervention as a part of the automatic editing process. Automation itself was insufficient in producing video remixes that would suit user’s (especially the artists’ in Publication III) impression management goals. Also, making the remixes manually gave satisfaction for those who did them. This kind of personal production can be an important factor for the users. Earlier research has shown that people feel happier about the outcomes that they have accomplished themselves compared to similar outcomes that have been accomplished by someone else or by chance (Ellsworth 1994), and competence (e.g., one takes on and masters hard challenges) and autonomy (e.g., one is free to do things one’s own way) are important in forming satisfying events (Sheldon et al. 2001). As a matter of fact, creativity is an essential part of many social media services, like photosharing services.

In Publication IV, many considered it important to be in control over whether or not their names would be mentioned as part of a public remix. Although the automatic remixer was considered trustworthier than unknown human peers, control over the use of one’s own name in public settings was important. People wanted to make sure that a published remix did not violate their impression management goals. In Publication V, the teacher did not feel the automatic monitoring of pupils doing the mobile exercises supported the communicational needs of teacher–pupil interaction. She felt that the tracking information the system produced was too generic. An example highlighting the importance of manual intervention was that the teacher did not use the automatic system but innovated her own concept, where she instructed pupils to manually write her a personal SMS after they had done the exercises. This, she felt, was a more pleasant and intimate way, and it enabled her to have a deeper interaction with her pupils. In Publication VI, one of the privacy concern categories was the users’ inability to modify the

nuance and veracity of the disclosed content. Users did not have the option of disclosing less-specific information about their state of affairs or adding to the content so that they could explain the context of their behavior. However, as discussed in the publication and found by Silfverberg et al. (2011), in some contexts a certain kind of manual intervention, for example lying, might violate the social norms of the group and not be considered proper behavior by the user community. Therefore, whether or not manual intervention would actually be considered to support UX can be a socially constructed process.

In a nutshell, all the case studies revealed the result that it is important for designers to seriously consider implementing affordances for manual intervention. The control to manually modify the information content can enchase self-presentation possibilities, make users feel more attached to the service, make the use feel more meaningful, and ease privacy concerns.

Design implication: Consider the possibility of manual intervention and participation and, if implemented, make sure that the user is aware and knows how to take advantage of the possibilities.

6.1.5 Inability to Understand the Logic of Automation May Lower Control of Social Situations

Understanding the logic of how the automation works can improve user experience. In Publication I, the users had problems in understanding the logic, timeliness, and accuracy of automatic location data. They also did not spontaneously explore the logic, but only when automation prevented them from achieving their communicative and social ends. In Publication III, the understanding of the logic of automation affected how people took video during the music event. People had assumptions about the capabilities of the AVRS and guided their video recording based on those assumptions. This had consequences on what kind of raw material the automatic remixer had available to use. In Publication VI, one of the major privacy concerns was related to transparency of the logic of automation. The location disclosure and photosharing contexts were especially prone to making users feel that they were out of control and in the dark about what information the systems were acquiring and how they were analyzing the information, and for what purposes, other than the users' own, the information might be used.

Therefore, it should be made clear for the user what the system is capable of and what are its limits. The consequences of having the right mental model on the logic of automation bring up the fact that the user does not see beyond the information the user interface displays, yet important social interaction related decisions are determined by the automation. In social media, design decisions made in the middleware or backend of the system and how well those are

communicated to the user can be critical for the UX. Operation logic of pervasive automation may not be obvious to the user simply because of the multiple hidden layers of processing that affect a perceivable outcome. In design, emphasis should be put on how to inform users about the logic of automation so that they have abilities to project the possible social consequences of the automated actions.

Design implication: Consider lower levels of automation where the system, though implementing actions without asking the user, still informs the user about its doings. Consider access to history databases and features that assist the user to project the possible future consequences of social media actions.

7. Discussion and Conclusions

People use social media with a myriad of communication devices, such as smart phones, tablet devices, and personal computers. In recent years, different communication devices have become more seamlessly connected to each other, for example, in compatible ways to connect to each other and the Internet. A user can choose whether she wants to use social media with her smart phone, tablet, or even a wristwatch connected to the Internet. Thus, the use of social media has become less device-dependent. In addition, devices' abilities with respect to media creation and consumption have developed significantly. For example, the nature of mobile phones has changed drastically from those used only for calling or text messaging to a "smarter", programmable communication device fulfilled with embedded sensors, and which people use while on the move to take photographs, take video, and listen to music, just to name few functions. In addition, the wireless Internet connection has enabled the created media to be shared through myriad social media services in immense amounts.

With the advances in context-sensing and analysis technologies, the creation and sharing of media has also become more automated. With respect to this change, the case services in this thesis are prime examples. However, they are just the tip of the iceberg of context-aware social media services. For example, in late 2011, Facebook introduced so called frictionless sharing as part of their Open Graph protocol, a way to automatically, in real time, share content on Facebook about users' everyday lives online and offline activities, such as reading news online, listening to music, and travelling.

New technologies and applications are developed continuously. Future technological advancements, such as wearable technologies (e.g. an internet connected wristwatch or glasses), enable new areas for sensing (e.g sensing biometrical data). These may enable tracking users' activities and surroundings a lot more accurately than through a mobile phone, which may often be carried in a bag or left on a table. Therefore, the boundaries between automation and user control are and will be continuously explored. The results of this thesis show that all-or-nothing automation can be problematic for the user experience. If one has only the option to share everything or opt out of using a service, it is unlikely that the user's needs will be fulfilled with such on-and-off automation. Users can practice control outside the system, but more fine-grained control possibilities inside the system are needed to fully support the user experience.

Every human technology is designed based on assumptions about the activities it is built to support (Suchman 2007). Therefore, the designer should have an accurate understanding of the

users goals and practices in specific contexts. In context-aware applications the understanding of the goals and practices come in when it is figured out how could sensing technologies support those and fit the user's understanding of context. Although the case technologies in this thesis can be categorized under context-aware technologies as defined by Dey et al. (1999), it is important to remember that this categorization is drawn from technological perspective that has its roots in scientific (positivist) theories. These theories seek to simplify context into mathematical and objective models and do not process the notion of context as a subjective, and dynamic interpretation of the world like the phenomenological theories do (Dourish, 2004). On the other hand, it may be that the simplifications done from the positivist theories perspective actually makes the design and development of context-aware technologies more actionable in real life, since the view is more practical and engineer oriented. As the results of the thesis shows, the context-aware features where functions are automatically triggered through the sensing of surroundings are far from perfect. Yet, they are still able to support the user experience if the level of automation fits user's instrumental and emotions goals in the context at issue. On the other hand due to simplification of the notion of context, the context-awareness of a service may not reach the real goals the designers and developers might have had in mind. This may be due to disparity of user's and machines interpretation of the context. Although, how the system understands user's context (and triggers functions based on that) may not fit perfectly to user's understanding of the context it does not necessarily mean the system is useless. People can find strategies to overcome the limitations of technology, and it often occurs that people use the technology differently from the assumptions of the developer (Dourish 2004) (although in extreme negative cases they may neglect using the technology entirely). The results of the thesis indicate that control possibilities (technical and non-technical) available for the user may help to fill the gaps between the system's and user's interpretations of the context (e.g. manually revert, modify, or delete content in a social media service). This results that due to a possibly imperfect context interpretation by the system, the level of automation should be considered carefully.

7.1 Returning to the Research Questions

This thesis started by noting how automation brought by the evolving context-aware computing is changing people's ways of social interaction by automating tasks in social media services. The question proposed at the end of the Introduction chapter was:

> What are the user experience implications of introducing automation to processes that are inherently social in nature?

When designers and developers create new social media services, they have the option to decide on the level of automation in social media tasks. The main argument of the thesis is that, as in process industries, in social media, automation can assist users in their tasks but does not fully replace humans. The paradox with automation in social media is that social interaction is a process that cannot be fully automated even in theory. After all, what would fully automated social interaction be, interaction between computers without humans?

Rather, in social media, automation has unique costs and benefits, and there is always a trade-off between the pros and cons. Two research questions guided the formalization of this thesis, and they were answered by studying diverse users using a diverse set of social media services in real-life contexts:

RQ1: How can automation support the user experience in context-aware social media?

This question aimed at addressing how allocating social interaction-related information processing tasks to a computer could assist a user in the use of social media and enhance the service's user experience. The results showed that automation can be used in social media to assist a user in being more aware of her social surroundings (e.g., sending notifications of social events) and assist a user in making her social interactions fertile (e.g., assisting in coordination among groups and bringing new opportunities for ad hoc encounters) and can be perceived as trusted with respect to the user's impression management goals (e.g., remixing user-generated media with other media and publishing it online). Automation can also offer the user a channel to participate in and contribute to collaborative social media activities without a requirement for understanding and handling the complexity of the activity itself.

RQ2: What challenges does user face with automation in context-aware social media?

This question aimed at addressing how automation fails to fill or has difficulties in filling its idealistic goals and the resulting negative effects on the user experience of the service. The results showed that, while automation assists the user, it also takes control away. This can pose challenges for the user to correctly interpret the social information mediated by the service, sustain satisfactory privacy regarding both information from others (input) and information to others (output), and control the impression that other people form of her.

The question is how automation can be designed to support the user experience in social media. Based on the results of this thesis, the answer lies in how automation, by assisting the user in her pragmatic, instrumental tasks, also supports user's hedonic goal, such as expressing herself and interacting with relevant others on the level she desires. Gaining efficiency, the principle that is often linked with the motivation to increase automation, is not suitable for social

media design. It is more important to design people's social interaction goals up front than to make the pragmatic tasks more efficient.

However, designing with users' hedonic goals up front can be problematic. Designers have to understand that social interaction-related processes are dynamic. For example, people's desire to interact with others, such as the preferred degree of closeness and openness, vary over time and depend on the context. If the service is automated on an unsuitable level and cannot be integrated into the user's social practices, the user will take over the service and practice control outside the automated social media task. Users can change how they regulate their own behavior regarding the actions of the service, modify the service to suit their goals, or generate auxiliary social mechanisms to ensure correct interpretation by others. However, if automation restricts control too much, it can cause the user to withdraw from using the service as whole.

To address the problem of designing automation that supports the user experience, the thesis proposes several implications for design: 1) social constructions and personal motivations affect the user experience of automation; 2) increasing automation does not guarantee a good social media user experience; 3) high-level automation may produce privacy concerns; 4) the possibility for manual intervention can support the user experience; and 5) the inability to understand the logic of automation may lower the control of social situations.

To support the user experience in social media, the thesis proposes that designers systematically consider alternative levels of automation when designing to implement automation. It is valuable for the user experience to analyze how much room is left for the user to interact with the system. For this purpose, the levels of automation framework by Parasuraman et al. (2000) is a useful framework that guides developers to consider what is done at the different stages of automation: action implementation, decision selection, information analysis, and data acquisition. However, the framework's locus is in interaction between human and computer. It does not take into account the user's control mechanisms outside the system's influence. Therefore, control outside the system and the trade-offs between user control inside and outside the system should be considered. This thesis emphasizes that the selection between user control and automation is also a trade-off. Too little automation might create new challenges, for example, related to usability (e.g., constant interruptions by the system might make use cumbersome).

Finally, this thesis reminds us that, in social media, the ubiquity of technology cannot be achieved by automating all that is technically possible and thinking that it will cause technology to vanish into the background. The true ubiquitous nature comes from real-use experiences where the automation and users collaborate in a way that integrates technology into people's social practices.

7.2 Validity and Applicability of the Results

This thesis consists of five field studies and one cross-case analysis of three field studies. As part of the field studies conducted for the thesis, four different social media technologies were studied. As a whole, qualitative interview was the main data collection method, diversified with quantitative data logs, questionnaires, and focus groups in particular cases.

7.2.1 Validity

The validity of the results were affected mainly by four factors: the sample of users who participated in the studies, how well the selection of the case technologies present automation in context-aware social media, how well do the data gathering methods bring out the implications of automation for user experience, and how valid the analysis of the research data is.

For each field study, humans were the main source of data. Because the main data were the participants' subjective descriptions about the use of technology in their own lives, the data were limited by the participants' ability to correctly remember and describe their experiences with the services. In addition, the number of participants in each study was limited due to resource constraints. Therefore, a more extensive sample of participants would have given more valid results. Also, in each of the conducted field studies, the participants had not used the studied service before the study. Therefore, they were not "genuine" users in that way but used (or at least tried and tested) the services due to participating in the study. However, in none of the studies were the participants forced to use the service; rather, the objective was to determine how the service and its automated features integrated into the participants' everyday lives.

Regarding the versatility of the case services, the limiting factor is that they are just a sample from the social media world. Regarding context-awareness, they could be put under what Schmidt (2013) calls proactive applications and function triggers, which use context information to trigger functions on behalf of the user. Schmidt's (2013) categorization also includes other types of systems, such as context-aware user interfaces. Furthermore, some of the services (Jaiku and Socially) were off-the-shelf products, but the mobile learning system and the automatic video remixing system were prototypes that were being developed as part of the study. Therefore, the services might have had usability issues that also affected the users' experiences with automation. Also the context-awareness abilities of the systems could have been better. In addition, all the cases of this thesis concentrated on technologies that had high levels of automation. Therefore, understanding the benefits and costs of intermediate and low-range automation for the user experience was limited. However, in each case study, the participants

also had experiences with the manual execution of the automated tasks. Therefore, a comparison between manual and automatic interaction was possible.

From methodological point of view this research used field studies to study how automated features of various kinds of context-aware social media technologies supported or conflicted with users' social media goals and practices. Although the results revealed instances from both aspects, there could have been a more complete and comparative picture drawn from the point of view how the user perceives the context and how (should) the system perceives the context. An alternative approach could have been to purely ethnographically observe the users' practices without a case technology (e.g. practices of using Facebook (publication II) or participating in music events (publications III and IV)) and study what aspects of those contexts make the users' actions meaningful for them. Then with system developers it could have been evaluated what are the current possibilities to develop technologies that would support users in their goals and practices by allocating some of the tasks from user to the service. This kind of approach has a significant history in HCI (e.g. Bentley et al. 1992; Perry et al. 2009).

As the research data was mainly qualitative, the question of validity arose due to the subjective nature of the process of considering the data. An ideal way to increase the validity of the results would be for several researchers (or even totally outsiders) to examine the same data and their results compared. Unfortunately, this was not possible for this thesis due to resource constraints. The author of the thesis was the main person to analyze the data. In some cases, the data were analyzed in cooperation with other researchers. Therefore, the possible hidden prejudices of the researchers might have constrained their thinking beyond the established concepts in their minds. To increase the validity of the results, all of the publications (I-VI) contained direct quotes from the participants. Thus, the reader was also able in some cases to analyze the data while reading the publications. In addition, in some cases, such as with user-reported use activity, quantitative data logs were used to back up the qualitative data.

7.2.2 Applicability

The author believes that the results have the potential to be applied both academically and commercially. Academically, the thesis opens a novel perspective for the research in the domain of context-aware social media services since social media has not been analyzed systematically from an automation perspective before. Furthermore, the thesis contributes to the field of HCI by presenting detailed descriptions of how people use social media services and how task allocation to a computer affects user interaction with the system and the user experience of the service both positively and negatively. In addition, the design implications can help in designing future social media service prototypes and avoid the shortcomings of the studied services.

Commercially, the thesis has potential for improving the user experience of future social media services and other everyday services that contain automated features. The results highlight, for example, the problematic nature of all-or-nothing automation in social media and propose that the designers of commercial services should also consider alternative levels of automation. Furthermore, the results highlight the need for designers of commercial services to understand the basic needs of the potential customers and the dynamic nature of control needs when users maintain and build social relationships as part of social media use.

7.3 Future Research

This thesis is only a roadside station in the research and development of ubiquitous social media technologies. It has its roots in decades of research in human-computer interaction, and after it, there are still a myriad of unexplored questions to study. The aim of this thesis was to start filling the gap in understanding how automation affects the user experience and what related issues should be taken into account when designing social media services. Although it provided some answers, it also raised new questions. At least four paths of research were revealed.

First, would it be possible to automatically find usage trends and social norms from social media services if large amounts of social media usage data were available for exploration? For example, the use of Facebook has evolved and taken new forms due to human-computer interaction, where the development of the service (e.g., new use opportunities and new visual designs) has affected people's usage habits and the usage habits affected the development of the service (e.g., new privacy settings), respectively. If usage habits and norms could be automatically categorized and patterns found, it could open up possibilities for new kinds of personal social media assistants that could, for example, notify the user if she uses the service against the current, recently evolved norm.

Second, this thesis has concentrated on user experience. Therefore, the perspective has been user-centered and omitted the other stakeholders' points of view. Service ecosystems have multiple stakeholders, which have their own motivations, requirements, and values. Design trade offs exist. For example, often, a social media service is financially valuable to the service provider because it can collect user data and thus attract advertisers to the service provider. This again may conflict for example with users' privacy. It can be tricky for the system provider to please the users and the advertisers simultaneously. Therefore, an area of research that could benefit HCI community would be to study the underlying motivations service providers have for their automation related design decisions, and how well could service providers increase users' trust on the service and reduce the concerns related to privacy by making their practices transparent. It can be hypothesized that high automation should be linked with more transparent

and rigorous privacy practices to gain the trust of the users. However, this might compromise usability.

Third, social media services are introducing features for aggregating and distributing information about their users between services. Aggregation brings new challenges to user experience research and touches on, for example, privacy. For example, Facebook's frictionless sharing introduced the automated sharing of behavioral data on the site from third-party services. An example of this aggregation is Spotify, which has started streaming music-listening information to users' Facebook profiles. However, another music listening service, Pandora, has not started streaming music-listening information because it believes that music listening is a very private experience. Automation design choices are not straightforward. For example, Facebook has evolved through continuous development and iteration. Therefore, another important area of research is to study the user experience implications of automatically aggregating multiple pieces of information from separate services into a single service.

Fourth, more comprehensive quantitative information on the costs, benefits, and user needs would be beneficial in designing future social media services. If it were known how people quantitatively value different aspects of the costs and benefits of automation as part of their social interaction activities, it might help in designing a more suitable ratio of user control to automation. As discussed earlier, if people cannot control their social interaction using the control mechanisms of the service, they will control it outside the service. However, all user control requires effort from the user. Little is known about how people evaluate control outside and inside the system. Furthermore, quantitative research on how people value basic human needs as part of various social media activities is non-existent. At one point, automation may satisfy the basic need of relatedness, but at the same time, it may decrease users' feelings of autonomy or competence.

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"I Can't Lie Anymore!": The Implications of Location Automation for Mobile Social Applications

Sami Vihavainen, Antti Oulasvirta, Risto Sarvas, *Helsinki Institute for Information Technology HIIT / Helsinki University of Technology TKK*

Abstract— **Human factors research has shown that automation is a mixed blessing. It changes the role of the human in the loop with effects on understanding, errors, control, skill, vigilance, and ultimately trust and usefulness. We raise the issue that many current mobile applications involve mechanisms that surreptitiously collect and propagate location information among users and we provide results from the first systematic real world study of the matter.**

Our observations come from a case study of Jaiku, a mobile microblogging service that automates disclosure and diffusion of location information. Three user groups in Finland and California used Jaiku for several months. The results reveal issues related to control, understanding, emergent practices, and privacy. The results convey that unsuitable automated features can preclude use in a group. While one group found automated features useful, and another was indifferent toward it, the third group stopped using the application almost entirely. To conclude, we discuss the need for user-centered development of automated features in location-based services.

Index Terms— **Automation, human factors, location information, mobile social applications, privacy, user-centered design**

I. Introduction

AUTOMATION is utilized extensively in human activities ranging from product manufacturing to chemical and power plants, space vehicles and robots, heating and air conditioning, business systems, medical devices, home appliances, and stand-alone computers. Human factors research has shown that automation is a mixed blessing. It changes the role of the human in the loop with effects on understanding, control, skill, vigilance, and ultimately trust and usefulness [21]. Many present-day mobile applications involve mechanisms that surreptitiously collect and propagate location information among users. The *raison d'etre* for location automation in these applications is productivity: a mobile user does not have the time and resources to *manually* post and update her location information. Moreover, automation is always a temptation. If the system *can* capture and share more information, why *not* do it?

But what are the implications of introducing location automation into mobile applications that are inherently *social* by character? In this case, the "process" that is being "controlled" here is social by nature, not safety- or performance-related. The implications of automation to computer-mediated social interaction have not been systematically addressed although the question is of utmost importance for information and communication technology. It can be justifiably predicted that the implications will go beyond productivity-related issues. This area of interest, especially from non workplace communication perspective, has recently also brought up for example by [19] as part of important future HCI research.

We consider this issue relevant to the Mobiquitous community, because whenever we design middleware or UIs for automatic location-disclosure, we subscribe to a model of automation that may or may not be suitable for users. *The user does not "see" beyond the immediate information in the user interface, yet important decisions on self-disclosure are determined by the automation.* There are many open questions, like: Which models of automation are acceptable in location disclosure in non workplace related communication? How do they affect interaction and use? How can control mechanisms be designed for the user?

We present a case study of Jaiku to provide first data on this matter. Instead of general aspects of user experience or usability of the user interface, we focus on automated features that in a way "exist" beyond the user interface in the system that collects and propagates location information to other users. Our goal is to shed light on three broad questions, the first two we believe are unique to mobile social applications. The third has been studied extensively in human factors, but not in this application context:

This study was part of the Finnish Funding Agency for Technology and Innovation (TEKES) project Täky. Antti Oulasvirta was supported by the Academy of Finland project Amoveo.

S. Vihavainen is with Helsinki Institute for Information Technology HIIT / Helsinki University of Technology TKK P.O. Box 9800, FIN-02015 HUT, FINLAND (phone: +358 44 348 2517, e-mail: sami.vihavainen (at) hiit.fi).

A. Oulasvirta is with Helsinki Institute for Information Technology HIIT / Helsinki University of Technology TKK, P.O. Box 9800, FIN-02015 HUT, FINLAND (e-mail: antti.oulasvirta (at) hiit.fi).

R. Sarvas is with Helsinki Institute for Information Technology HIIT / Helsinki University of Technology TKK, P.O. Box 9800, FIN-02015 HUT, FINLAND (e-mail: risto.sarvas (at) hiit.fi).

Digital Object Identifier: 10.4108/ICST.MOBIQUITOUS2009.6847
http://dx.doi.org/10.4108/ICST.MOBIQUITOUS2009.6847

1. Use of automated features in mobile social applications
2. User response to automation
3. Users' understanding of the logic of automation

As a case, we study location automation in an application called *Jaiku*. Fig. 1 represents Jaiku's user interface. In a nutshell, Jaiku is a mobile awareness service that allows a group to share textual status updates that are associated with *automatic location information*. Moreover, a number of *awareness cues* are provided. At first blush, these two automatic features look quite harmless. Under the surface, however, both applications involve quite complicated automation to control the construction, propagation, utilization, and visualization of these data. We start the paper by analyzing these models, leveraging the levels of automation framework from human factors.

Fig. 1. The user's perspective to Jaiku. The UI shows contacts' status messages with location cues.

The next main part of the paper presents the study and its results. By studying three user groups' use of Jaiku our goal is to gain a more general perspective to the phenomena, instead of pooling results from an individual user group. Interviews and log analysis were used as the main methods of data collection. At the end of the paper, we return to the challenges that automation pose to mobile applications.

A. Overview of Jaiku

The next sections outline a detailed automation model Jaiku uses, but at this point we want to provide a general overview of the system to concretize and contextualize our work. Jaiku (see Jaiku.com) is a Nokia S60-based mobile awareness service built on the ContextPhone platform [17]. There are three concepts of relevance here, which also dominate the UI of the Jaiku mobile client (see Fig. 1):

1. *Status messages:* Users can post status messages of 140 characters that are viewable by their contacts using a mobile client or Internet browser (microblogging). In our studies we focused on within-group use, although Jaiku allows also for public publishing. This is not an automated feature, as its contents are fully user-controlled. The automated features are meant to support status messages and in a way contextualize them.
2. *Location label:* Parallel to the status line there is location information which shows *a label* for the user's GSM cell ID. This feature is automated (partially), as we will discuss in a forthcoming section.
3. *Awareness cues*: In addition, Jaiku provides a separate screen with real-time sensor-derived indicators (awareness cues) such as online status, alarm profiles, number of other people in proximity and the next calendar event. This feature is also automated (partially), as we will discuss in the forthcoming section.

II. Related Work

A. User studies

A growing body of good user studies of location awareness application is emerging [5], [7], [8], [9], [10], [15], [22]. Many of these are made in workplace context and not in socially more complex leisure environments. Many of these papers also note briefly that automatic features were used or noted by the users, but only a handful give the issue more weight. In what follows, we go through them in more detail.

Barkhuus *et al.* [5] studied an awareness system called Connecto that allows users to tag locations and share them, automatically or manually, on a mobile phone. The goal of the study was to understand how location awareness would work within a close-knit group of friends. They recruited two separate groups of friends. However, they did not do any comparison between the results from each group. Their users manually controlled, otherwise automatic, location mostly when they needed to "freeze" the location for others. The main reaction reported related to better communicativeness that can be achieved via manual overriding. The users were not reported having shut off the automatic disclosure for reasons of privacy.

Brown *et al.* [7] studied a system called Whereabouts Clock. Whereabouts Clock is a desktop terminal, a 'clock', which shows the location of each family member based on their mobile devices' current locations. The authors' starting point is that a key aspect of family activities is to know other members' whereabouts and routines. The system was used by five families, all of whom used the clock quite actively and reported no significant problems in its use. However they did not present any specific results between the families or explored the social boundaries of the system with other types of groups. Moreover, location-disclosure was of low fidelity—the clock only enabled one to see if another member is physically at home or not.

Consolvo *et al.* [8] conducted an interesting study where they studied whether and what the users are willing to disclose about their location to social relations. They conducted a three-phased formative study. Their results show that most important factors are: who is requesting, why the requester wants the location information, and what detail would be the most useful to the requester. However, they did not do any real world user trial on automation related questions.

Harper [9] used Active Badge location technology for studying social organizations of two research laboratories. He states that the one's role within the *moral order* of the

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http://dx.doi.org/10.4108/ICST.MOBIQUITOUS2009.6847

organization affects on the acceptability of a new technology in workplace organization. For example in workplace the information on the location may be a *status quo* in case of the receptionist, but not in case of an individual researcher. However, in his study Harper does not concentrate on automation and also focuses on workplaces with formally specified hierarchy and which social relations are more static than leisure time social groups'.

Iachello *et al.* [10] studied the awareness application Reno, which allows querying the locations of friends and disclosing one's own location to them. In addition to non-automated (i.e., fully manual) disclosure, location names can be set to be revealed to *selected contacts* automatically, or upon entering a pre-specified location. The results show that participants did not use automatic features almost at all. The main reason stated is that they did not fully *trust* they would *work properly* and they did not feel a subjective need for setting up the automatic features. However, only one out of eleven expressed privacy-related concerns as the reason. The authors' conclusion was that there is no need for automatic location disclosure in Reno.

Want *et al.* [22] studied a building based location system Active Badge in office working environment. They used wearable electronic ID badges to automatically disseminate location of the participants. The building had detectors that recorded participants' location in every 15 seconds. Using a computer user was able to locate the participants based on map or a textual interface. The system also showed who were in the same room with each other and the nearest telephone number. They report that the system had many advantages such as the incidence of telephone calls not reaching the correct person dropped. In addition they also reported problems related to privacy. They reported that to most people first reaction for personal location system was horror but that after 2 weeks mandatory use many continued using the system. However, Want *et al.* studied the system in workplace environment which lacks the social complexity of everyday life and does not take into account such diverse areas as play and expressiveness.

Taken together, automated features have been associated with mainly to four issues: understanding, user needs, communication, and privacy. However, previous studies do not recognize that all the four issues are explicitly related to the level of automation in the system's features. Thus there was a need for systematically study automation in social mobile media. The results do not lend strong evidence for general usefulness of automated features in either, for example usefulness with microblogging—a finding that our study can elaborate. By comparing three user groups, only one of which preferred the automation of Jaiku, we wish to illuminate how group structure and activities affect which forms of automation are useful and acceptable.

B. Location automation

In this subsection, we do not intend to provide a thorough review of the state of the art. Instead, by providing a few examples, we want to illuminate the recent surge in the number and variety of location automation solutions.

Much of the technology research in these types of services focuses on better ways of producing *accurate* location information using existing network infrastructures (*e.g.*, GSM, GPS and Wifi). See, for example, [11] and [23] for location determination in WiFi networks. The production of accurate location has also strong business incentives, and different technologies and algorithms for generating accurate, fast and reliable location information are turned into business (see, *e.g.*, Skyhook wireless). Junglas and Watson [12] list three challenges for the adoption of location-based services: more accurate location information, faster response times, and privacy concerns raised by users. As we will attempt to argue later, the model of automation will affect how much users put weight to all of these concerns.

Against this backdrop, our contribution to research in location-based services is in studying location information in a mobile social application. In other words, the use of location information in Jaiku is primarily *social* interaction between people, not for example, a search function (*e.g.*, show me the closest gas station).

TABLE 1. LEVELS OF AUTOMATION ACCORDING TO SHERIDAN [20], [21]

1.	The computer offers no assistance; the human must do it all
2.	The computer suggests alternative ways to do the task
3.	The computer selects one way to do the task and asks for human approval
4.	The computer allows the human a restricted time to veto before automatic execution
5.	The computer executes the suggestion automatically, then informs the human
6.	The computer executes the suggestion automatically, informs the human if asked
7.	The computer selects the method, executes the task, and ignores the human.

III. UNDERSTANDING AUTOMATION IN MOBILE SERVICES

Since we talk about automation of location information, it is necessary to start by explaining our terminology. By location information in Jaiku we mean the information displayed in the user interface right after the status updates (see Fig. 1). The location information is identified by the word "in". For example, in Fig. 1, for the user "Petteri Koponen" the location information is "London". We do not attempt a broader definition at this point. Conceptually the location information in Jaiku is metadata about the user and the status line. It is technically coupled with the user's phone: it changes as the user's phone's cellID changes, or if the user changes the label manually. Visually the location information is embedded into the status line as it is appended to the end of it.

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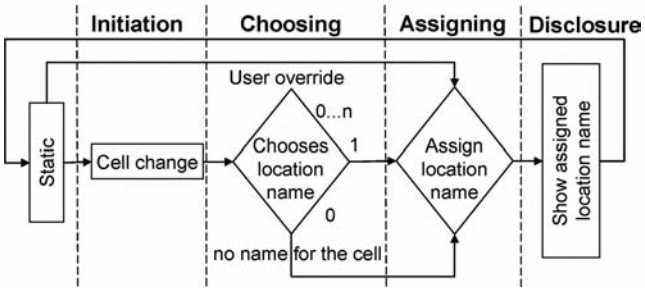

Fig. 2. Automated processes in Jaiku

A. Automation models in Jaiku

Sheridan [20] has proposed a level of automation framework. The levels range from no assistance from a computer to a computer is in full control without informing the user (Table 1, previous page). We believe this framework suits well the description of how automation works in Jaiku. Four consecutive processes can be identified:

1. Initiating location information change,
2. Choosing location label,
3. Assigning location label, and
4. Disclosing location label.

All of these can be automated at any of the seven levels. Fig. 2 presents the flow chart of the automated processes. To contextualize the results of the user study, it is necessary to describe in some more depth the complex workings of location automation in Jaiku.

1) Initiation of location information change

The first part of location automation in Jaiku is the initiation of the location information change. In Jaiku, this part of the process is triggered whenever the phone's cell tower changes. The user, of course, cannot know when this happens as these cells are not visible in the environment. However, with practice the users may learn where cell boundaries are. Because the user has practically no means to know when a cell tower changes, she/he has practically no *control* over the initiation. Initiation triggers the next steps: choosing, assigning, and distributing.

2) Choosing location label

As mentioned above, the location information is acquired using the cellIDs. For each cellID and username pair, there are 0…n options for location labels. If the user has previously input a label for the cellID at hand, then that single label is the result of the analysis. If the user has input no label for the given cellID, then the user's *contacts* network is searched for whether any user within the network has given a label. If no one in the user's network has given that cellID a label then the result is null. If there is several labels then the system chooses one (the algorithm is unknown to us). Importantly, the user has no means to affect this process other than shut down Jaiku. It is unlikely that the users understand the logic of choosing, as we will discuss later.

3) Assigning location label

The third part of the process is the assignment of metadata to a username. In Jaiku, this is fully automatic *unless* the user overrides this by typing in a location label. Thus, manual overriding is possible. If the user does *not* choose to override it, the metadata chosen in the previous process is automatically assigned to the username. If the user chooses to type in a label, the typed label is assigned and stored into the system's database. Importantly, the user has to actively initiate this because Jaiku in no ways prompts the user to write anything. Next time the user's Jaiku enters the cellID it will automatically choose the typed label.

4) Disclosing location label

The last part in this process is the disclosure of the assigned label. It means that the application sends the assigned label to the user's contacts' Jaiku clients; not directly, but through the Jaiku server. Each of these clients then updates the UI (Fig. 1) to show the label in association with the status line. This is fully automated, the user has no means to control when to disclose and to whom. Shutting down the application and manually removing entries from the contact book are the only options for control here.

B. Speculating broader social implications of automation

The Before moving on to our study, we want to provide some background on possible social consequences of location automation in light of studies done in human-computer interaction. These are speculations but relevant because they guided the calibration of our data collection methods.

In Jaiku, the automatic disclosure of personal information can be speculated to have effects on three mobile device mediated activities. The findings of the study show effects (negative and positive) relating to the two first ones. First, mobile phones cater a handful of channels through which users coordinate shared activities and [4], [11], as part of that, disclose information about themselves. In this activity, automatic disclosure may have the advantage of saving a person from continuously updating others with current location and plans via SMS or calls [15]. However, if the disclosed information is not useful, it may be add to information overload on the side of the receiver. Second, mobile phones are one channel in which people engage in negotiation of privacy. Palen *et al.* [16]] write: "The boundary between self and other is destabilized when phone users assume that they are without an audience." Continuous disclosure about oneself may erode users' ability to control this process and result in that they reject the system, inhibit its use, turn off automatic disclosure or establish extraneous practices to repair the damage done. Third, mobile device communications contributes to maintenance and deepening of social relationships. A significant factor in this process is the reciprocation of self-disclosure. Communicators tend to model the level of intimacy in each others' disclosure, and people who do not respond with reciprocal disclosure, or who disclose too much, are generally disliked [2]. Automatic

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disclosure may be too rigid, reveal too much information or too little, and thus may have to be "repaired" explicitly by the conversant. By the same token, continuous automatic disclosure of one's "true" activities may conflict with the images one desires to convey.

IV. The Study: Three Field Trials of Jaiku

Three groups (students, birders, hipsters) were recruited in Finland and California, and they used Jaiku for two months. A mix of quantitative (content logs) and qualitative (interviews) methods were used in order to gauge both interaction on the phone and subjective views on automation.

A. User groups

1. The Students were a group of 5 men and 5 women, ages from 18 to 20 years, living in the Helsinki metropolitan area (Finland). They spent time together in school and in their free-time. During the trial, they had several joint events, such as a ferry trip to Stockholm. Many of them participated in a preparation course for university entrance exams. The participants were not particularly tech savvy but were moderately fluent users of cell phones and the Internet.

2. The Birders were a group of 7 men and 1 woman, ages from 18 to 64. Birders were an interest group, all belonging to a bird watching club in Helsinki. Four Birders knew each other beforehand, but the rest had not met prior to the study. During the study, many Birders traveled frequently in southern Finland. Almost all communications within the group was about bird watching. All were active users of a national bird observation service (Lintutiedotus) that distributes information about recent observations via SMS.

3. The Hipsters were a group of 4 men and 4 women, in their 30's and living in the Bay Area, California. Three lived together and there were 2 dating couples. All shared a similar life style that is commonly called "hipster" and spent plenty of time with together. The Hipsters were not particularly tech savvy, except two men who used the Web in their work. All members were fluent in using cell phones and services on the Web, such as Web shopping.

B. Procedure

All participants were provided with Nokia N70 phones and free data plans. They were introduced to the application in pre-trial group sessions. While our instructions focused on the use of the application and its UI, we also had to explain basics of the automated features, for example, automatic location diffusion. We encouraged them to use or to at least try the features (e.g., manual overriding of location labels).

Two weeks after the start each user was contacted to check that everything was working. All groups used the application for two months. No other reward than free data plans for the time of the trials was provided.

C. Data Collection

1. Interviews. The users were interviewed individually about their social networks, communication practices, how they used Jaiku, what kind of feelings they had about the application and how they used and understood the automated features. We asked them to express general opinions but also tell concrete, real episodes of use. The interviews took place at users' homes, work places, or schools. 41 hours of interview data were gathered. The protocol had the structure described in Table 2 below.

Table 2. The interview protocol.

1.	Warm up discussion
2.	General communication with other people (e.g. Who do you communicate with on daily basis?)
3.	Jaiku in general(e.g. Jaiku in your own words?)
4.	Usability (e.g. was it hard to learn to name locations?)
5.	Privacy (e.g. How do you like the fact that your contacts can see your location?)
6.	Presence line (e.g. Why have you written presence lines?)
7.	Location (e.g. Tell me about the last time you wrote your location in Jaiku)
8.	Checking contacts' information (e.g. Tell about the last time you checked your contact's location)
9.	Effect of Jaiku on use of other comm. channels (e.g. What was Jaiku's effect on SMS use?)
10.	Needs (e.g. Has Jaiku been useful to you?)
11.	Final (e.g. How would you develop Jaiku?)

2. Logging. Logging consisted the data described in Table 3. A shortcoming in our logging is that we could only access location labels as they were sent with the messages, but not when users manually updated their location labels. This shortcoming precludes a thorough analysis of users' practices in manually updating/overriding labels. However, most of the time when a user updates location manually, it is done with the purpose of disclosing it with the message. Therefore, most updates are caught in our data.

Table 3. Data logged in the user trials.

1.	User ID
2.	Written presence line
3.	Location where the presence line was written
4.	Time and date the presence line was written

V. Findings Part 1: Use of Automated Features in Concert with Messaging Functionality

In this section, we describe the usage of the application's communication functionality, its main designed purpose, from the perspective of the automated features. Statistics on use and opinions convey differences among the groups.

A. Sending messages

Jaiku was a new application to all users, and there was a learning phase in all groups to establish a way to use the system. The basic concept of an awareness system (an

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application that enables the user to communicate her location and activities to her friends) was clear for all users.

TABLE 4. SYSTEM ACTIVITY IN THE THREE GROUPS.

	Students	Birders	Hipsters	SUM
Users	9	8	8	25
Period	4-6/07	4-6/07	9-12/07	
Sent Jaiku Messages	1004	550	53	1607
Locations written	112	122	11	245

During the two months, the 25 users sent 1607 messages and wrote 245 location tags. Table 4 shows the Jaiku activity of the groups.

The Students were the most active group. During the first month they used Jaiku mostly for messages to the whole group, typically containing insider comments, and telling about whereabouts and doings. During the second month, Jaiku was used also for one-to-one messages, despite the fact that they were visible to the whole group. They wrote locations frequently in Jaiku, and said they enjoyed following their others' locations.

The Birders were relatively active Jaiku users sending 550 messages and writing 122 locations. In the beginning they used it mainly for reporting birds. Many of the locations named were bird watching places or names of towns in the visited areas. Later on they started to write also about topics not related to their hobby because Jaiku was not perceived as efficient for bird reporting as the existing SMS service.

The Hipsters were the most passive user group, sending only 53 messages and writing 11 locations. Especially in the beginning, many of them had concerns about privacy, saying that it felt "creepy" that Jaiku automatically tracks them. In addition, a few felt that it was unnecessary to be connected more than they already were through other means. Also, many did not get used to the battery drainage. For these reasons, which we will elaborate later on, some of the Hipsters switched it off.

B. Intentions to control location labels

We interviewed the users on how they control location diffusion and determine the contents of location labels. Generally, the users spent little effort to control the automation.

The Students told us that the location information of Jaiku was useful and they were interested in each others' locations. They named 112 locations. The main uses they mentioned were 1) coordination and 2) having new opportunities for ad hoc encounters, as in the following passage:

> "If I see that [participant] is 'in [library A]' and I'm in [library B], I just write 'lets get some food' [to Jaiku's presence line]. If he doesn't notice I can text or call him" - M18

They hardly ever overrode the automatic locations, except for a few occasions, often for the reason of increasing informativeness:

> "I changed [name of a building] to [a restaurant in the same building]. I think that tells more for this group." – F19

For Birders and Hipsters, the disclosure of movements in real-time was not interesting. The Birders did not have any shared activities outside bird watching, and even that was not an activity done together. Nevertheless, they did name 122 locations, but this was because they traveled quite actively in Southern Finland. Moreover, the naming of locations dropped significantly after the first month. Even though the Hipsters were good friends and spent time together, they found hardly any use for the location information in Jaiku. The group named only 11 locations.

It seems like the automated location disclosure, together with the presence line, was useful only for the Students who knew each other quite well and interacted with each other frequently. Contrary to other groups, many of their daily activities were shared and automatic disclosure contributed to the coordination of mobility and communication relevant in these activities. For the more heterogeneous groups, Birders and Hipsters, automatic location had little value or use and therefore, they spent little time controlling it.

C. Enhancing communicativeness with manual overriding

A central feature of Jaiku is that users can always type their own location label which will override the automatic ones. To study how this happened, we categorized the location labels according to the (subjective) size of the geographical area they referred to. This informed us if the cellID location technology is accurate enough for these uses from the perspective that labels have *communicative functions*.

TABLE 5. GRANULARITIES OF LOCATION REFERENCES

	Stu-dents	Hip-sters	Bird-ers	Total
Area < neighborhood	55 %	36 %	27 %	**40 %**

1) Categorization of location label granularity

We created and applied a simple categorization for the label data. All user-created labels were categorized according to granularity, i.e. the size of the geographical area the label refers with the simple split point:

1. area ≥ neighborhood
2. area < neighborhood.

For example, location names like "home" and "library" were categorized in the second category. However, some labels, like the name of a tourist resort did not fit well in this "urban" categorization. The amount of non-categorizable items was small, though (~2%).

2) Pin-pointing with more accurate labels

Table 5 reports the results of this analysis for Jaiku. This analysis shows that the locations written by the users were often quite specific. Jaiku's UI gives users two categories of

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places to name: "neighborhood" and "city/region". However, analysis of the user created names showed that 40% of the written locations referred to a location more specific than neighborhood. Perhaps unsatisfied with the communicative effect of their location labels, the participants overrode the GSM cellID based automatic with quite specific locations (e.g., "home", "café", "library"). Unsurprisingly, places that were visited often or considered important had a more specific label:

> "I have named places I visit more often. There is 'home', there is 'gym' and there is 'Prisma' [supermarket]" – F19

The Students named locations more precisely than the two other groups. The Students had specific places known to everyone in the group, which was probably a factor in their detailed labeling. In contrast, the Birders were mobile and traveled around the southern part of Finland to various bird watching places and their group had very little shared history. Therefore, their labeling was not that detailed.

3) Non-location referencing

We then examined in a second exercise to which extent written labels refer to something more meaningful than geographical areas, for example, 'home' or the name of a cafeteria. *Altogether 36% of named locations had another meaning than a geographical area.*

There were a few cases where a location label made visible the event the user was participating in. For example, during the trial most of the Students were taking a course together and the location of the place was named by one of them as "[teacher of the course]". However, for an outsider, the location "[teacher of the course]" would have been ambiguous. Another example is the "[name of an office building]" that was changed to "[name of a pub in the building]". The name of the pub told more about the context of the person than the name of the building.

D.A note on the probable effect of audience

From the two above analyses, referring to "insider information" in labels worked in the small groups. Many participants told that if the location labels in Jaiku were disclosed outside the group they would use more *general* names:

> "If there would be others (outside the group) I would not name the place as [the university the user was going to applying], I would just write the real name of that place. It is after all [the institute where the participant was taking a preparation course before applying to the university]" – M19

Thus, our observation that the automatic location labels were often "enhanced" with manual ones is most likely partially explained by the nature of the user groups.

VI. Findings Part 2: User Response on Automation

In this section we characterize the user groups' experiences on the usefulness of automation and its perceived on their shared activities. Two out of three user groups thought that the automated features had practically no impact on their activities, the exception being the Students.

Indifference (Birders). The Birders' view on Jaiku's location automation is best described as indifference or neglect. They did not bring up any particular privacy concerns, but found little use for the automatic disclosure either. This was probably because they did not have close ties and there was little risk in accidentally disclosing personal information. Simply put, the Birders were so distant that it did not matter if the rest of the user group knew their location and could follow them.

Initial Conflict and Withdrawal (Hipsters). The majority of Hipsters had a negative first impression about the concept of Jaiku, and one reaction was: "I can't lie anymore." The automatic location disclosure conflicted with the group's structure of privacy. They were not used to knowing about each other in real-time on a daily basis. One of the few active Hipster users occasionally checked if his girlfriend was at home, and if she was, he might call her because he knew it meant she was available. This user said: "With Jaiku you can get a light touch with your friends." However, because many of the users were not logged in all the time, the automatic location disclosure had little value and could not be used reliably. Thus, the negative impacts that were predicted did not realize among Hipsters because they simply neglected the system or switched it off.

Part of the Communication Toolbox (Students). The Students were the only one exhibiting a clear benefit from Jaiku's automation. When using Jaiku, they used the automatic features for coordinating shared activities and to get information about each other's whereabouts. They used automatic location disclosure, for example, when participant A noticed that participant B was nearby and A sent a Jaiku message to he suggest a joint lunch. They also learned to use location disclosure for checking the other's availability to receive calls:

> "For many it says like " [preparation course]". That tells they are there, you don't want to call them then. You can call them later" – M18

Jaiku became a part of their communication toolbox, using it to draw conclusions about which communication channel to use in different situations and coordinate mobility. For example, they looked at the other's automatic information to decide whether a SMS or a call would be appropriate. Despite being the most involved group, the Students showed no strong privacy concerns. However, they did speculate that *if* their parents or their boy/girlfriends belonged to the group, they would use Jaiku differently.

VII. Findings Part 3: Understanding the Logic of Automation

We interviewed the users about their understanding of the concept of automation in Jaiku. The question of users' understanding is a classic human factors topic. As previous sections have explained, the workings of location automation

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in Jaiku are not obvious (even to researchers who must deduce the logic from observable behavior of the application), simply because of the multiple hidden layers of processing that affect a perceivable outcome. In comparison to human factors studies, the incidents we report convey the idea that the logic of automation mainly became problematized by users when the automation prevented them from achieving their communicative and social ends. In other words, they did not spontaneously explore the logic, out of pure curiosity or as part of familiarizing with the system.

A methodological note before reporting the results. Our participants were initially introduced to how locations are diffused in Jaiku, and this must of course have influenced their capacity for understanding. Despite this introduction, which is more than average users will go through, several problems emerged. With less instruction, we surmise that the problem of understanding would be more pronounced.

A. "You are still home?": Problems with diffusion

Despite this introduction, some users forgot the basics and did not know if location names are diffused for all Jaiku users or only among the contacts. Jaiku does not make transparent its logic of diffusion and, unless told by a third party, it is very hard for a user to figure out the diffusion logic herself. Some also confused the difference between presence line and location information in Jaiku. Two participants mentioned how they first wrote location names to Jaiku's presence line because they did not understand that writing in the presence line is not similarly automated as the location line.

The problem with diffusion was worst in the Hipsters group. A couple living about one mile from each other had both named their home location in Jaiku as "home," and when the woman visited the man's home, they noticed that her Jaiku also showed "home." They thought that the accuracy of location technology was so poor that it did not change the woman's location. However, this was an artifact of the way Jaiku propagates location labels between users. As was discussed earlier, the diffusion of Jaiku's location information sparked strong opinions and privacy concerns.

B. "Still in a meeting?": Misinterpreting timeliness

There were also problems with inferring from Jaiku's UI if information is *up to date*.

For every contact Jaiku's main menu shows when the user last used Jaiku (e.g. looked at contacts' information) and the current presence line (status message), [[last time of activity]:[presence line]], e.g. "11 hours ago: going home." This does not mean the presence line is updated but only that the user has done something with Jaiku.

One Hipster told looking at a friend's presence line,"1 hour ago: in a 2h meeting,". However, it later turned out the status was already several hours old but the time "1 hour ago" was updated the previous time the user was online in the system. Jaiku has information on how old a status update is, but that has to be viewed from a different menu. Unsurprisingly, this caused problems in knowing how old or new the information was. A simple remedy is to indicate already in the user interface if location data are obsolete.

C. "It was really S.F.": Accuracy and reliability

In Jaiku the location information is acquired using the GSM network cell tower identification code (cellID). Jaiku has three location categories: Country, City, Neighborhood. Country is automatically fetched from the phones country code and City and Neighborhood are user created names for specific cellIDs. However, the system gives the user no information about *the real accuracy of the location.* Users have no knowledge of the fact that GSM cellIDs determine the accuracy, neither can they observe the boundaries of GSM cells in their environments.

Not surprisingly, the users were often confused with the accuracy of automatically disclosed information. The majority of Students mentioned that it was unclear how large the geographic span of a named area is:

> "I don't know how large the geographic span of a named location is. There is this city/region, but how large is it in reality? "– M18

This user-initiated "repair" of accuracy, in addition to function of enhancing the status messages' communicativeness, were main reasons for the result (reported above) that 40% of location labels referred to finer geographical areas than what the cellID-based system allows.

D. "In Having Coffee": Making Sense of Intended uses

The users also had problems in understanding Jaiku's main menu that shows the contacts' location and presence line (status message) in format: *in* [location]*:* [presence line]. This is intended to show the users what their contacts are doing and where they are doing it. Also both location and presence information have different input menus where the user the user can write and submit the information.

Having problems understanding the logic, timeliness, and accuracy of automatic location data, some of the participants were struggling to see its *purpose* in Jaiku. As said above, they sometimes wrote their locations in the presence line, and also, wrote non-location information in the location line (*e.g.,* "having coffee", which shows in Jaiku as "*in* having coffee"), mixing the intended purposes of the two. Although the latter was possibly done intentionally it most likely obscured the norms of use within a group.

VIII. Discussion

This study is the first reported empirical study focusing on automation in location-based services. It showed how the automation related questions are essential factors affecting user experience of location based systems, and should be taken seriously when designing mobile social applications.

The results reveal both "classic" human factors problems with the automation's logic and novel issues related to the fact that location automation at times compromised their control of social situations. Relating to the first class of problems, the users did not always understand the geographic area covered by GSM cell IDs, the timeliness of the data when other users were off-line, or the purpose of real-time location disclosure.

Digital Object Identifier: 10.4108/ICST.MOBIQUITOUS2009.6847
http://dx.doi.org/10.4108/ICST.MOBIQUITOUS2009.6847

Relating to the second class of problems, we see many effects from privacy to abandonment of the application. Only one group found real benefit from Jaiku—the Students who used it for coordinating shared activities and ad hoc encounters. In these pursuits, the automated location information was useful but often insufficient. In 55% of time the members of this group labeled locations more accurately than the GSM cell-based technology really supported. The two other groups exhibited indifference and withdrawal toward Jaiku, but their reasons were different. The Hipsters were initially worried about privacy problems and generally felt that they do not need such a channel as they already interact with each other often enough. They rarely logged in and used it mainly to check others' availability. Although the common activity of Birders was spatial by nature, they did not have simultaneous collective efforts, and they did not know each other outside the interest groups, with the result that the automatic information was simply uninteresting and need not to be controlled. Automation was a non-issue to them. These differences highlight the importance of needs, activities, and structures of the intended user groups as factors for acceptance of automation.

In reference to the three questions we set in the beginning, our observations can be summarized as the following set of claims about automation in mobile social applications.

Use of automated features in mobile social applications:

1. Automation can threaten accountability of actions. When automated data are mixed with manual data in the UI, the danger is that the communicative functions of tags and manual location labels are lost.

User response to automation:

2. The negative effects of automation at the level of the group include neglect in the face of useless automation, and withdrawal in the face of a too threateningly strong model of automation.
3. Privacy concerns are felt but do not necessary actualize due to the measures the users can take both inside and outside the system.
4. The nature of shared activities, and the usefulness of the automated information therein, shapes whether automation will be useful, useless, or annoying. The level of automation, and its content, should be chosen according to what is known about these activities.

Users' understanding of the logic of automation:

5. The negative effects of automation on the individual reflect the classic findings of human factors. Particularly, ignorance of automation, misunderstanding of its operating logic, post hoc "repairs," repetitive behavior (re-sending location labels to ensure they appear), and eventually shutting down of the system can emerge.

A. A thought experiment

A broader point we have made in the paper is that Sheridan's levels of automation framework is useful for thinking about location automation. The framework shows that for any mobile social application there are numerous options on how to implement different features. Importantly, as a consequence of changing an automated solution from one level to another, interaction and the whole concept can change. If we make a thought experiment and take Sheridan's *all seven levels for each of the four processes* in Jaiku, we get 7 x 4 matrix. For each of the four stages we have seven different ways of implementing the automation, and hence, get 2,401 different ways of implementing location automation. In our case, the production of location information was divided into four processes. Other systems may have simpler or more complex constituent structures. The breakdown of different automation design choices shows that the "design space" is anything but simple and trivial

The results of the study and the previous thought experiment about the complex design space of automation in social mobile application also makes visible two assumptions about automation that may be problematic. First, productivity should not be seen as the dominant goal when designing automation. Indeed, Jaiku's automation may have increased "productivity" of Students by creating location information without burdening the user, but as the data shows, this may give raise to a myriad of other (deeper) problems. Automated processes are intertwined with the social practices, attitudes and prejudices of the users. However, if the system was more flexible, and users could change the levels of automation themselves, it might make the system more suitable to various types of users and groups. For, example, people inside a user group might have different norms related to specificity of disclosed location. The user should be allowed to set the level of how specifically her location is disclosed. This should also be independent on how specifically the user's contacts show their locations or how specific the location names named and diffused by them are.

Second, the automation's "locus" in this context is not between the human operator and the operated machine as is common in human factors. In mobile social applications the key processes occur between humans. In effect, these processes are constituted by elements outside the system's influence. The paradox of automation in this context is that it should automate a process, which by nature cannot be fully automated. Importantly, changing the model of automation will change how well the system integrates into to the social practices of the user group. Especially non workplace related social environments, such as group of friends, might vary in complexity and formalization. As this study showed, when designing a group communication system like Jaiku, the target audience should not be categorized as vaguely as a group of friends. Both the Students and the Hipsters were a group of friends but appropriated to the systems very differently. A major reason for that was the fact that the automated features of Jaiku suited the Students but were unsuitable for the Hipsters. This calls for including proper user trials as integral part of system evaluation.

We hope that our study has opened a door in designing better applications and middleware for location-based

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services. We hope it showed how important it is to systematically take into account the various levels of automation when designing the processes of location-based applications. In a social context of use, the automation of location information should facilitate the user to easily communicate with other people. The goal of automation is to make in the use of location information in everyday social contexts flexible, transparent, and understandable. The goal of automation is not primarily to increase effectiveness or accuracy.

Our study also points out that the design of automation in location-based services is not a sole matter of user interface design. The design decisions made in the middleware or backend of the system can be critical for what the user interface is able to display and the users fathom.

IX. ACKNOWLEDGMENT

We thank Sauli Tiitta and Mika Raento for support in organizing the study, and Jamie Munger and anonymous reviewers for comments on manuscript.

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Digital Object Identifier: 10.4108/ICST.MOBIQUITOUS2009.6847
http://dx.doi.org/10.4108/ICST.MOBIQUITOUS2009.6847

The Implications of Mobile Notifications for User Experience of a Social Network Service

http://dx.doi.org/10.3991/ijim.v7i2.2373

Sami Vihavainen[1], Kaisa Väänänen-Vainio-Mattila[2]
[1] Aalto University, Espoo, Finland
[2] Tampere University of Technology, Tampere, Finland

***Abstract*—Smartphones enable an always-on connection to Social Network Services (SNS). A typical way of interacting with SNSs is to access them when the user has a suitable situation to check the status of her social networks or to write an update. One way to enhance the usage of SNSs is to have the service automatically push notifications about events to the smartphone user interface. However, there is no research on how users experience such SNS notifications. We present an explorative field study with 11 participants to assess how users experience mobile notifications compared to reading SNS content manually, initiated by the user. The participants first used Facebook for a month without notifications and then for a month with an application called Socially that sends frequent notifications about Facebook events to the user's smartphone desktop. The participants who kept the notification feature on reported increased reading of Facebook. However, after a while, many were unwilling to receive the notifications, mainly because of lack of control. We report the qualitative findings on user experience, which reveal for example, that the use of mobile notifications decreases interest in Facebook. Notifications limit user control, and using Facebook feels more meaningful when accessed manually. Implications for design are discussed.**

***Index Terms*—Mobile notification, Social Network Service (SNS), Field study, User experience.**

I. INTRODUCTION

Social Network Services (SNSs) are increasingly a part of people's everyday lives. They are used to maintain contact with acquaintances, both close ones and more distant ones [1]. Nowadays, SNSs are often used with smartphones. There are mobile SNS applications, for example for Facebook and Twitter, which enable people to follow their friends' doings and socialize with them while on the move.

Features of automation have been developed for SNSs, meaning that some tasks that were previously performed by the users are allocated to the SNS. For example, location sensors of a smartphone perform automatic "check-ins" on Foursquare [2]. This kind of automation reduces the need for users' "manual" or user-initiated interaction with the service while supporting access to a broader set of information.

Recently, automation has been offered also in the form of mobile notifications. Notification systems have been defined as "interfaces specifically designed to support user access to additional digital information from sources secondary to current activities" [3]. Mobile notifications inform the user about happenings on an SNS by pushing information on the smartphone desktop. However, earlier research has shown that from the user's perspective, notifications are a double-edged sword. Notifications are valuable to the user in conveying important or relevant information, but they also come at the cost of interrupting the user [4].

How users experience notifications for SNSs has not been studied. To fill this gap, we studied the user experience (UX) implications for mobile notifications on SNSs in the field. By user experience, we mean users' subjective experiences, which arise from user-system interaction in the context of use. User experience covers both pragmatic (practical, goal-oriented) and hedonic (emotional, non-instrumental) aspects of system use [5]. A field study with end users using a system or a service in real contexts of use is a strong method to gain understanding of the details of user experience [6].

In studying mobile notifications, we focus on how service automatically follows happenings on the user's SNS, analyzes the acquired data, decides what information to deliver, and delivers that information by pushing the information to the user's phone as a notification. Thus, the system works as an assistant to follow activities of other people, which is a principal motivation for using services like Facebook [7]. We consider this to be an important area of research because notifications, if properly implemented, can enhance a user's social interaction by assisting the user in being better aware of the happenings in her social circle. However, it is important to the user experience that the notifications' interruptions are not perceived to be irritating.

To study the user experience of mobile notifications, our main research question was as follows:

How do mobile notifications affect the user experience of social network services?

We conducted an explorative field study with end users using Facebook with an existing, relatively widely-used mobile application called Socially [8]. Socially pushes News Feed updates from users' Facebook contacts to users' mobile phone desktop based on predefined time intervals; 30 minutes was the default setting. It also gives a light sound and vibrates the phone each time a new notification pops up. With Socially, the user is also able to manually read the Facebook News Feed by opening the News Feed screen and looking through the updates. Our approach was to study a group of current Facebook users, introduce them to Socially, and gather and analyze data on how they use Socially in connection with Facebook.

Our aim was to explore the user experience of mobile notifications and provide insight to designers to consider

when designing SNS functionality in mobile contexts. From a broader viewpoint, we explored the potential of automatic features in the SNS context, i.e. how tasks can be transferred from a human to a machine in mobile social applications.

In the remainder of this paper, we will first present related research followed by the research methods. We will then present the study process and the results. After discussing the design implications for mobile notifications and automation for social media, we will provide conclusions the contributions of the study.

II. RELATED RESEARCH

In this section we examine research related to notifications in Human-Computer Interaction (HCI). We also briefly present the concepts of automation and perceived control and how these concepts relate to notifications.

Previous research has found that if properly implemented, notifications can support people's awareness of others' social states, actions, and activities [9]. However, notifications generate an interruption, and it is not self evident that they are perceived positively by users. The benefits of interruptions must outweigh the detriments [3]. McCrickard and Chewar [3] argued that users' possible dissatisfaction with notifications is due to designers' failure to estimate user task prioritization. This results in notifications presented at inappropriate times and in an unsuitable presentation style. Earlier research has also found that intensity, which can be "scaled from not notifying at all to trying explicitly to grab the entire user attention" (p. 3), is affected by the presentation modality and the amount of information presented to the user [4].

Notifications can be used also in mobile devices such as smartphones. However, the use contexts of mobile devices are diverse, and the user is normally performing some other primary task. Therefore, the notifications have to compete with the user's environment to get the user's attention [10]. User attention is limited; it has even been proposed that in today's information society, attention is the scarcest resource [11]. Because a notification generates an interruption, a notification appearing at the wrong time and too intensely generates annoyance. It is unwise to get the user's attention at all costs. Several approaches to notifications, such as information filtering, choosing modality, and attentive UI, have been proposed to get a user's attention in a satisfactory way [10]. The mobile context also sets requirements for notifications because the interaction events with mobile phones are often short and fragmented [12], such as checking Facebook happenings while on a bus [13]. In addition users accept notifications more quickly if they are timed to appear at the end of mobile interaction episodes rather than at random times [14].

Recent research has also examined easing the user's burden to keep up with SNS events by aggregating events from several SNSs. For example, Cui et al. [15] developed and studied a LinkedUI application that enables the user to follow several SNSs in one consistent user interface. They found that the user preferred the aggregation approach to accessing SNSs through a traditional mobile web browser. LinkedUI decreased difficulties such as in switching windows and delays loading web pages. Overall, in the mobile and web environment, there are several ways to inform the user about changes taking place on SNSs or other web services. These change indicators can reduce the user's burden in looking for new content [16].

Automation means that some aspects of human activity are transferred to the system. This also means that control is partially transferred from human to machine. Different levels of automation can be built into HCI [17], from full machine control to full user control. Notifications implement a form of automation, which means that the machine (in this case the SNS and/or the mobile device) takes control of when the user should start interacting with the SNS.

Psychology research [18] has investigated the notion of control. Control refers to "the extent to which an agent can intentionally produce desired outcomes and prevent undesired ones. When individuals believe they can do this, they are said to have personal control, perceived control, or a sense of control" (p. 554). In information systems, perceived control has been found to affect users' motivation to use the system. Novak et al. [19] found control to be a major determinant of the flow experience with online environments, which again affects the depth of interaction with the service. They defined control as the "user's perception of her ability to successfully navigate through the Web environment and her perception of how the Web responds to her inputs" (p. 27). On the other hand, lack of perceived control may cause desperation and hopelessness [20]. In the HCI context, it is important to avoid negative emotions, and that user has the impression that she is in control of situations [21]. In addition, people feel happier about the outcomes that they have accomplished themselves compared to similar outcomes that have been accomplished by someone else or by chance [20].

Earlier HCI research has looked into notifications and automation usage in domains other than SNSs. In psychology, perceived control has been explored as a concept that may improve the user's experience with the system. In our study, we investigated how mobile notifications, as a form of automation, affect the user experience, including the user's sense of control.

III. SYSTEM DESCRIPTION

In our study we used Facebook and Socially to study the user experience of mobile notifications. With Socially, the user is able to read Facebook (and Twitter, Linked In, and Foursquare) by starting Socially and opening Facebook News Feed manually (Figure 1) or by reading notifications that the system pushes from Facebook (Figure 2). The user is also able to write status updates. Socially has other features that were not the focus of this study, including notifications during incoming calls, caller location, and synchronizing Facebook profile photos and birthdays with the phone. In our study, we used version 2.10. Based on the Facebook site, there were about 50,000 active users (27.10.2011), and the application had a 3.9/5.0-star average rating based on 173 reviews on Facebook.

Socially scans the user's social network services (e.g., Facebook or Twitter) and pushes new update notifications as a pop-up to the phone's desktop (Figure 2).

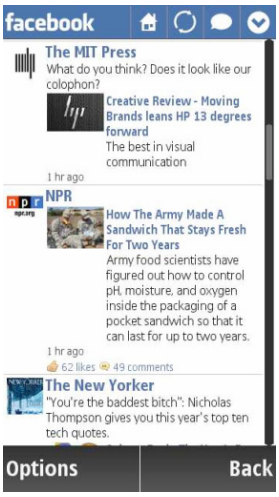

Figure 1. Socially's Facebook News Feed reading view.

Figure 2. Socially pushes recent updates to a phone's desktop at predefined time intervals.

When the new notification pop-up appears on the desktop, the phone gives a short audio alarm and the phone vibrates. The audio alarm is about 0.5 second (knock-knock-knock). Volume follows the phone's general ringing volume settings. Vibration cannot be turned off. It is possible to set the updates to come in time intervals of every 30 minutes, one hour, four hours, once a day, or never. The default setting has the phone push Facebook updates to the phone's desktop every 30 minutes. The updates are the most recent updates that would appear on the user's Facebook News Feed. When the notification appears, the user can scroll through the updates one by one, using the phone's arrow keys or push Read or Exit. The maximum number of new updates to scroll through is 15 per notification. Pushing Read opens a view where the user can read and scroll through the entire News Feed, as shown in Figure 1. Pushing Exit closes the notification. It is also possible to shut the feature off either by turning off Desktop alerts or setting the update time interval to Never.

Pushing the social notifications to the phone's desktop makes the phone work for the user by keeping an eye on what is happening on the user's SNS. This potentially enhances user's awareness of her social surroundings. She does not have to manually check the Facebook News Feed; it is delivered to her phone's desktop.

IV. FIELD STUDY

We recruited 11 participants for this qualitative study from the greater Helsinki area in Finland. We conducted a study in the field where we first studied participants' Facebook use strategies and then the use of mobile notifications through Socially in concert with Facebook.

A. *Users and Devices*

The users were recruited from the SizzleLab [22] living lab environment. There were nine males and two females. All were young adults from 19 to 27 years of age (mean age = 23.3). All had used Facebook in their everyday lives before the study. Of the total, 10 had Nokia N97 phones, which they had used as their primary phones for at least six months before the study. One participant had an HTC smartphone with an Android platform. All the participants also had unlimited data plans. The phones and data plans were provided to the users for free.

B. *Data Collection*

1) *Field Study*

Use of an existing application was studied in the everyday life context to better reveal the social and technological issues that unfold only in long-term real life use and might not come up in laboratory and prototype conditions. The field study had two phases. In the first phase (Phase A), people's Facebook use activities and strategies were studied. This phase lasted from 26 to 41 days (an average of 31 days per participant), depending on the users' personal availability for the study. In the second phase (Phase B), we intervened and introduced the users to Socially. We asked the users to use Socially with Facebook. We instructed them to use the application as they wanted but encouraged them to at least try it. This phase lasted from 31 to 46 days, depending on the participant's availability (an average of 41 days per participant).

A pseudo-Facebook profile was established for the study, and all the participants added the pseudo profile as their Facebook contact for the period of the study. This was done to log how often participants updated their Facebook profiles during Phase A and Phase B. Participant privacy was taken seriously, and access to the pseudo profile was granted only to researchers who were part of the project group. All the data related to participants was anonymized for publication.

The participants installed Socially in their phones themselves. Because we wanted them to use the application as realistically as possible, we did not want to force them to use any of its features. However, all participants were introduced to all the features. They were asked to send us an e-mail or SMS check when they had successfully installed the application, and we told them to ask for help if they had any problems. We provided technical support if needed. We did not reveal to them that the focus of the study was notifications. As a reward, each participant was given a 50€ fee at the end of the study.

2) *Open-ended Questionnaires*

During the field study, two open-ended questionnaires were conducted. The first took place in the middle of Phase A and concentrated on the participants' Facebook use habits and experiences. The second was conducted at the beginning of Phase B and concentrated on first

reactions and experiences with Socially and if the participants had had any problems with it. Both questionnaires included real-life examples. At this point, we kept the questions quite general so that our research focus would not be revealed and so that the questions would not direct participants' use of Socially.

3) Final Interviews and Questionnaires

At the end of the study, we interviewed the participants. Six participants were individually interviewed face-to-face. The five remaining participants were not available for interview. However, they were sent open-ended questionnaires, which were formulated based on the already conducted individual interviews. Interviews were semi-structured and consisted of reactions and use of the automated features of Socially. The interview protocol and the questionnaires covered the following areas:

1. Participant's background (e.g., age, technology know-how)
2. General use of the phone (e.g., whether it worked properly)
3. General use of Socially (e.g., perceived usefulness)
4. Experiences with Socially's notifications
5. Experiences reading Facebook News Feed manually
6. Whether they planned to use Socially after the trial and why

C. Data Analysis

Qualitative data from the open-ended questionnaires and face-to-face interviews was analyzed based on grounded theory as defined by Straus and Corbin [23]. This means that the theories or result themes are found bottom-up from the data, and no pre-study hypotheses are formed. Furthermore, qualitative data was analyzed using content analysis [24]. First, the key points related to data were identified. Then the key points were categorized into larger themes. Research questions were used to guide the analysis. Quantitative data on Facebook updates during Phases A and B was analyzed using a paired sample t-test.

V. RESULTS

In this section, we first describe users' interaction with Facebook during Phases A and B (Section A) to provide background on the users' Facebook habits and motivations (Phase A) and general use of the notification feature (Phase B). Section B summarizes the user experiences with Socially. We then present the main result themes that arose from the study data in sections D–G.

A. Facebook Interaction in Study Phases A and B

1) Phase A—Reading News Feed and Hanging Out

For most of the participants, reading was the main activity on Facebook; motivations varied from a need to keep up with happenings to a need to relax.

Many claimed that they use Facebook mainly to follow what their friends are doing or for private chatting and mailing, but they are passive in writing about their doings and whereabouts in the public status box. According to our questionnaire, on average, they read Facebook about 5.1 times per day. However, some were clearly more active than others; the standard deviation was 4.6. As everyone reported that they read Facebook every day, the users were active readers of Facebook.

Regarding Facebook contribution, we counted the times they had written a status update or sent a link (e.g., YouTube video or a web site) to their profile during Phase A. The total number of updates was 86. On average, the participants sent 0.26 updates per day; the standard deviation was 0.38. One of the users (P8) was a very active contributor, sending 1.2 updates per day on average, whereas five participants sent no updates.

Using Facebook seemed more serious to some than to others. For example, one participant described how he needs Facebook to be up to date on his friends' doings and new events.

"[Without Facebook] I would be so clueless about everything what happens." – P2

But many described their use as "hanging out". It was popular among the participants to read Facebook when there was nothing else to do. It was more about relaxing and passing the time than serious objectives. Using Facebook while on the move was popular. Half of the respondents reported that they have a habit to read Facebook while on a bus or a train. Nine participants had used Facebook with their phones before the trial. The majority reported reading as the main activity with the phone. The participants' basic Facebook habits were in line with earlier studies of SNS uses [7] and interaction moments with the service [13].

2) Phase B—Differences in the Use of Notifications

Overall, participants differed on whether they used the notification feature offered by Socially. Three participants (P1, P2, P6) kept the feature on for the entire use period (about 4 weeks) while six (P3, P4, P5, P8, P9, P10) kept it on from one to seven days; two (P7, P11) did not use it at all. Next, we will discuss these differences in the use of notifications. We will also elaborate on the findings by comparing them to earlier research. We will refer to the above-mentioned groups as High-users, Low-users, and Non-users. P1, P2, and P6 belong to the High-users; P3, P4, P5, P8, P9, and P10 belong to the Low-users; and P7 and P11 form the Non-users group. Non-users had problems understanding the logic of how the notifications feature works. P7 accidentally deactivated the notifications after installation. She deactivated the "Desktop Alerts" feature without realizing that it also prevented notifications from showing up. P11 had the feature on but he did not keep Socially running in the background. He did not realize he needed to keep the application running to be able to use automated features.

B. The General Effect of and User Experience with Socially

1) The Main Effect of Socially: Reading Increased But Writing Did Not

Six participants (P2, P3, P4, P5, P6, and P10) reported that Socially increased their Facebook reading but did not have a clear effect on how they updated their status lines. Four (P1, P7, P8, and P11) reported that Socially did not have a significant effect on how or how much they used Facebook; one (P9) reported it actually reduced her Facebook activity while the notifications were on.

The most important reasons participants reported for increasing reading activity was that it was quicker to

manually read the Facebook News Feed with Socially than how they had previous read the Feed; and because of the notifications (when turned on), they were persuaded to read the updates more often. In total, 160 updates were sent during Phase B, and only 7 were written using Socially. On average, participants sent 0.35 updates per day, with a variance of 0.50. On average, there were more updates sent per day in phase A (0.26), but the difference was not significant. Based on paired samples t-test, the difference between Phases A and B was not significant; the p-value was 0.078.

2) User Preferences and Experiences with Socially

Most of the participants reported that they liked Socially. Six participants (P2, P5, P6, P7, P10, and P11) planned to continue using Socially after the trial period. Three (P4, P8, and P9) were a bit uncertain, and two (P1 and P3) would not use it after the trial. The main reasons for continuing the use were notifications and ease of use. For three participants, notifications were one of the main reasons they wanted to continue using Socially. However, one (P11) did not understand that Socially had to be kept in the background. After he realized that, he wanted to continue using the system so that he could receive notifications. For three, the main reason was that Socially was easier and faster to use than other ways (web browser or Nokia's Facebook application). With Socially, it was convenient to open the application manually and pull the Facebook updates to the phone.

Most found that from a pragmatic perspective, Socially worked well. It was fast and easy to use. However, from a hedonic perspective, there was more variation among the participants. Many found that notifications were not pleasant and did not suit their Facebook use habits whereas some liked felt they were a bonus.

C. The Main Themes Related to User Experience of Mobile Notifications

During the analysis phase, four main themes related to user interaction with mobile notifications came up: Users had varying control strategies over notification interruptions (1); ease of skipping insignificant messages favored manual reading (2); notifications decreased interest in reading Facebook (3); and users' goals affected the perceived usefulness of notifications (4).

1) Users Have Varying Control Strategies over Interruptions

The effect of practicing control over notification frequency and intensity came up when comparing the High-users and the Low-users. Two from the High-users had made the update interval less frequent than the default setting of "every 30 minutes" (to "every four hours"). For them, notifications were actually one of the main reasons they wanted to continue using Socially after the study. One was bothered by the intensity (alarm) of the notifications. He wanted to keep the notification feature on, but because he could not turn off the alarm, he chose to lower the sound level of his phone. The third user who kept the notification feature on used the 30-minute default interval for the entire period. However, he kept his phone silent all the time. He said that he always keeps his phone on silent because the phone's alarms generally disturb him. For him, the notifications were not as intense as for others. But he did keep the phone's vibration feature on to be aware of incoming messages and phone calls. Of the six Low-users, none had practiced any control over the mechanisms of the notifications. All of them used the 30-minute default until they turned the feature off. Therefore, although the system had a mechanism for the user to adjust the frequency of notifications and to control interruptions based on weighting the value of interruption against the costs, they did not use this mechanism. They also did not control the intensity of notifications by adjusting the phone's sound level like two of the High-users did. The Low-users thus perceived the notifications as more intrusive than the High-users.

In addition to controlling the settings of the notifications, varying levels of behavior control practiced by the participants were reported. Two of the High-users said they read the updates practically every time they showed up unless they were in a hurry. But even they did not actually read the new status lines every time even though they might have checked the pop-up.

"But it's a different thing what I will actually do after I have opened the key lock. Will I push Read or Exit? It depends a lot on what else am I doing at the time." – P2

They managed to control the notification situations with their behavior: They simply did not pay much attention to notifications when they did not want to read them. Even unimportant notifications did not cause interruptions so severe that it would have irritated them as they were in the middle of their primary tasks.

Some of the Low-users related how they at first thought that the feature was pretty cool, but that after a short while they realized they would not need or want notifications about new Facebook updates but wanted to control their Facebook reading manually.

"I tried the feature for about three days but then it started to get on my nerves, when it beeped every day. I thought this is not for me because I like to go to Facebook often and watch the new updates by myself anyway." – P5

"Those kinds of things [notification features] are really neat. I was really excited at first, but then again in the long run it was not that good anyway." – P10

This brings up how the user experience can change over time. After the notifications were first considered useful, withdrawal occurred. Unlike the High-users, most of the Low-users did not report practicing much behavior control. Of the Low-users, five reported that they checked the notifications very often before inactivating them. Only one never really checked the updates but just ignored the update alerts. Low-users said that the alarm sounds Socially gave when sending notifications to the phone's desktop were disturbing. The alarm was too persuasive and one participant mentioned how she reacted physically to the alarms.

"I reacted perhaps quite physically to it. Like, hey! Now it alarms, I have to check it out." – P5

To ensure that the push alerts do not bother the user, Socially automatically stops showing updates at night. This window is from 9PM to 8AM. Although this was a nice feature, it was not enough because it did not adapt to the user's real life well enough. In the following case, the user's strategy to control notifications was eventually to shut off the notification feature.

"I really do not want to wake up during the weekend mornings because some half-acquainted person has added a YouTube-video to her Facebook wall. – P5

Earlier research [4] has shown that the intensity of notifications is influenced by the modality in which the notifications are presented, including whether they are silent or not. Based on the results, frequency seems to be a defining factor of the perceived intrusiveness of the notification system. The control possibilities for the user to adjust the intensity of notifications should not be overlooked or made too difficult. Users do not necessarily explore the control possibilities spontaneously but may turn the system completely off if controlling the notification is not easy enough.

2) Ease of Skipping Insignificant Messages Favors Manual Reading

Many participants reported that they wanted to control their Facebook reading manually by scrolling through the News Feed. This was because they felt that it gave them better control over what to focus on. There were two main reasons notifications were not perceived as a valuable way to follow Facebook. The social importance of one's Facebook contacts varied widely. However, notifications treated all the updates as equally significant. For example, one user had about 1000 Facebook friends and was not interested in getting all of those friends' status updates to his phone; for instance, he only gets one-to-one text messages that are directed only to him. Some participants had blocked some of their Facebook friends' status updates because they perceived that many were useless. The fact that this could not be done with Socially was disturbing. Several participants stated that the greater the user control in defining the filtering principles of Facebook status lines, the more they would like the notification feature. Second, mobile notifications emphasized individual messages whereas the News Feed shows several updates at the same time. With the entire News Feed on display, it is easier to control the unwanted, boring, and useless status updates by just skipping updates. It was considered important to control pre-filtering of updates and filtering during the reading process. Participants thought that there was a lot of unnecessary "noise" on Facebook that was not considered meaningful. Many were irritated that the notifications did not provide a meaningful extent to which user was able to intentionally produce desired outcomes and prevent undesired ones.

Showing one update at a time makes the first update especially important. Reading the first update can be a crucial moment of interaction when the user makes the decision to continue reading Facebook. One of the participants mentioned that when he gets notifications, he checks the first status update and based on that decides whether to explore the updates further or stop the prevailing interaction event.

"If that first one [status update] is something that does not interest me at all, I might push Exit and check the others sometime later just by doing it manually." – P2

Another user had actually never read other than the first one.

"I never continued reading the updates after the first one, because already the first one seemed useless." – P5

We consider this to be a valuable insight for designers. If the first shown status update were the most commented on or most liked, it might trigger a deeper interaction event and persuade the user to continue reading Facebook.

3) Notifications Decrease Interest in Facebook

Losing control of what to read and when decreased user interest in Facebook. For some users, notifications made the content of Facebook updates feel less meaningful. One of the Low-users noted that during the first days of use, she checked the updates every time. However, when reading her friends' status updates from the phone, she realized how irrelevant they were to her current context. After that "enlightenment", she said she used Facebook less than she would have normally because she learned to ignore the notification alarms but did not read Facebook manually from phone or from a desktop computer. She thought that there was nothing interesting on Facebook to read, but when she turned the feature off (after keeping it on for a week), she started to read Facebook from her desktop computer again.

"During that one week I opened Facebook from my computer only like two times. That was because all the updates came to the phone. But somehow I then noticed that if these all are this kind of crap, why do I bother reading them at all. However, after I stopped the push feature I started to use Facebook more often with a computer." – P9

For her, the push alarms were eventually annoying and made her uninterested in Facebook.

"It is weird, that suddenly it is really interesting if you do it by yourself, but not if someone pushes it to you." – P9

Another participant described similar feelings when reading Facebook manually and getting notifications.

For me it feels somehow more meaningful to check the updates manually, than if I am just being told [through notifications]. – P1

Psychology research has produced results similar to these findings. As previously mentioned, people feel happier about outcomes that they have accomplished themselves compared to similar (equally pleasant) outcomes that have been accomplished by someone else or by chance [20]. This might partly explain why reading the News Feed manually was somehow more meaningful than getting the same content delivered through notifications. During the manual reading process, the user accomplishes the interaction event whereas through notifications, something else is the primary agent accomplishing the interaction event.

4) User Goals Affect Perceived Usefulness of Notifications

Participants' Facebook use motivations and the goals they try to achieve by using Facebook affected how useful the notification feature was perceived. The High-users who perceived that the notifications enhanced the user experience of the system were keen on being aware of what their Facebook friends were up to. Two of the High-users discussed how Facebook was all about knowing what friends are doing and what kind of social events have occurred, are occurring, or will be occurring. One was actually surprised when we asked if the notifications had bothered him. The other felt that the notifications

were one of the main reasons he will continue using Socially after the trial. The third User (who kept his phone silent) explained that for certain intervals, notifications are a nice bonus. Overall, these users perceived that notifications helped them be more aware of the happenings in their social network. The value was greater than the detriment of notification interrupting the current primary task. Using the user experience related notions presented by [5]; for the High-users notifications enhanced the hedonic quality of Socially. This was because they wanted to be aware of others' social lives, and for this notifications were useful. Notifications enhanced the user experience of the service by explicitly supporting users' hedonic goal of being related to others. These users were more focused on following others than the participants who did not perceive notifications as useful and who used Facebook to pass the time and relax.

Four of the Low-users found that they did not want to enhance their Facebook use in general. Ironically, this is exactly what the notifications try to do. Although all the Low-users used Facebook quite actively in their everyday lives (as discussed in 4.3), it was not a high priority and was used to pass the time or relax. This was a significant reason why many of the Low-users did not like notifications. Therefore, the implementation of notifications was not in line with the users' hedonic goals of passing the time and relaxing. The Low-users perceived that their control of when to read Facebook was too limited and did not feel that automation supported their use goals. One of the Low-users thought that notifications take too much attention from more important tasks like studying.

"If one should be studying, and Facebook is such a temptation anyway and easy to get stuck with, these [notifications] just increase that danger." – P10

VI. DISCUSSION AND DESIGN IMPLICATIONS

It can be tempting for designers to add automated features to social media applications. Potentially, automation can increase the amount of social interaction and enhance the user experience. However, the findings of this study show that automation in the social media context is not all about efficiency and productivity. Concerning notifications, the user has to feel that notifications support motivations and goals in using the service and that the benefits overweight the intrusiveness of the generated interruptions. It is also important that the user has control over the intrusiveness of notifications. Careful consideration is required when implementing features that push SNS content to people's personal phones. Next, we will discuss our findings and offer recommendations on how to design automation in a mobile notification context. We will also discuss the broader implications of automation for mobile social applications.

A. Use Goals Are Significant in Defining Social Media UX

People can have various motivations for reading about happenings on SNSs like Facebook. Some might feel it very important not to miss information about their friends' doings whereas others might read SNSs only when they do not have anything else to do or want to take a relaxation break from more important tasks. Notifications made it efficient to be up to date on Facebook happenings. It did assist in the pragmatic goal of getting information. However, the use goals played a significant role in user experience. Designers should thus concentrate on supporting users' hedonic goals and not only pragmatic goals. As a concrete example, the service could have a feature that when first used would ask the user questions concerning her goals related to Facebook use and set up notification settings based on the user's answers.

B. Losing Control May Reduce Motivation to Follow SNS Updates

As the functions are automated, control is transferred from human to machine. This may lower the user's perceived control of following SNSs. Several participants reported that reading the updates manually made the information feel more meaningful, and they felt more motivated to read Facebook manually than by using mobile notifications. With notifications, the trigger for checking SNS updates comes from a machine. For most users, it was better for the trigger to come from the user herself. Notifications can actually decrease reading activity compared to manual reading, as was reported by one of the participants. In information systems, perceived control has been found to affect users' motivation to use the system [19], and the lack of autonomy of actions has been shown to reduce motivation [25]. Research indicates that people prefer accomplishing outcomes themselves to having them accomplished by someone else [20]. So it is important for designers of mobile notifications to consider the importance of perceived control for user experience.

C. Notifications Can Violate the Privacy of Information Input

Users can interpret notifications as an invasion of privacy. This occurs when privacy is understood not only as a possibility for the individual to control what other people know about her (output of information) but also the individual's ability to control the information flow about others to him or her (input of information). This input-output distinction of privacy has been presented by [26]. With notifications, user control of information input might be in danger, and lack of control can be perceived as a violation of privacy. For example, user privacy was violated when she was not able to sufficiently control getting a notification at 9 A.M. on Sunday morning about some half-acquaintance linking a YouTube video to Facebook. Her strategy of controlling her privacy was to shut off the notifications feature completely. We propose that when developing systems that suggest something that is not a high priority for the user, designers should concentrate on situations in which the user already interacts with his or her phone. For example, notifications could show up only when the user actively uses the phone. Thus, a severe interruption could be avoided. However, in these situations, it is important that the notification does not stand out too forcefully so it does not complicate the primary task the user is performing.

D. Activity recognition can support relevance of notifications

Activity recognition has been proposed as a way to automatically find proper moments for interruptions (e.g., [27] and [4]). The fast development of smartphones and ubiquitous computing has enabled smartphones to contain numerous sensors that acquire data on a user's physical surroundings as well as interaction with the phone and

phone's interaction with surrounding devices. For example, ContextPhone platform developed in 2005 records data from 16 different types of sensors that could then be used to trigger actions within a service that uses the data [28]. A more recent example is the Android operating system-based Funf [29], which is able to record data from over 30 different built-in mobile phone data probes [30]. It might be useful for developers of notification features to try to use built-in sensors such as an accelerometer, magnetometer, and GPS sensor to model the activities of the user. Such a sensor-based approach could reveal users' activities, such as whether a user is on a bus or cycling. Successful recognition of activities (see, e.g., [31], [32]) might enhance suitable moments for notifications. However, although this kind of adaptive automation might create a better user experience, it is likely that the user control is needed. We still (after tremendous advances in machine learning) seem to be in the situation where humans are vital to systems with automation [33].

D. Repetition Frequency of an Automated Task Should Not Be Extreme by Default

Designing automation in the mobile social context is not only about allocating tasks between humans and machines but also about how to inform the user about the possibilities and workings of automation. For example, if the settings of automated features could be changed by the user but the default setting is at one extreme (i.e., very frequent or very rarely performed automated features), the user might not even be aware of the possibility of delegating tasks to the phone, or the user might become so irritated because of intense automation that he or she turns the feature off. This happened with many of the participants — they got irritated partly because the pop-up frequency of notifications was so high. Notifications might have been perceived more positively if the default pop-up frequency had been, for instance, every two hours.

E. The Time Window for Automation to Assure the User of Its Usefulness Is Short

It took at most one week for users to decide whether the notifications feature was useful. The majority of the participants were positive about the feature beforehand, and they thought that getting the updates automatically to their phones' desktops was nice. However, after a week, the majority had turned the feature off because it did not adequately accommodate their needs and Facebook use. We believe this window is extremely critical in automated systems that in some way cause interruptions in mobile contexts. Although more data is needed to define a precise time frame during which users either approve or disapprove of the feature, the implication for design is that designer should make the system adapt to a user's usage habits fairly quickly. For example, after noticing that a user does not browse and read the pushed Facebook updates, Socially could automatically suggest alternative notification settings (e.g., lower notification frequency or silent notifications).

F. Users Must Be Able to Choose the Level of Automation Based on the Significance of Information

In SNSs, the sizes of social networks and the closeness of the contacts vary. For example, some of the participants had over 1000 Facebook contacts whereas some had about 100. Raising 1000 contacts' Facebook updates almost to the level of personal text messages was not perceived as useful. Only important messages directed specifically to the user were designated to be pushed to the phone automatically. The current iPhone and Android Facebook applications let users manage notifications by selecting what kind of messages the user wants as notifications, such as friend requests, events, or likes. However, the other solution could be to use varying levels of automation depending on the significance of information. Automation does not have to be all or nothing. For example, highly relevant information could include an alarm whereas information of less relevance would not, and the least relevant information would not be pushed as a notification at all.

Another important consideration is of course how to determine what is significant and what is not. One possibility would be that the user selects the automation level for different kinds of messages (e.g., friend requests, likes, etc.). Another possible direction for information filtering could be to combine automatic filtering (e.g., a crowdsourcing approach in which the system automatically filters out updates that have not been read or are not considered important by one's peers) and user control and lowering the level of automation by giving the user the option to include his or her own criteria (e.g., in form of tags) in the filtering algorithm.

Regarding the parts of the selection process where the user is not in control, a discussion about the values of design would be necessary. For example, the developer might want to raise the importance level of updates that contain names of some brands, meaning that notifications could be considered mobile ads. Making these kinds of decisions without informing the user might be ethically dubious and might also lower the user's perceived control of what to read on SNSs.

VII. LIMITATIONS OF THE STUDY

There are three limitations of this study. First, the number of participants was small. This qualitative study emphasized finding implications for designs using mobile notifications. Our aim was primarily to understand the details of the user experience, so we chose the qualitative approach. With a larger sample size, additional results on the quantitative effect of notifications on usage amounts could have been established. It is also possible that a larger user sample would have revealed further user innovations on how to use notifications to limit excessive Facebook use, such as by reading Facebook only when a notification pops up. Second, the results of the use and the effect of notifications were self-reported. Before the study, we tested and considered a context logging application to run in the background. However, because the Socially application was not our own but a commercial one, we did not have access to the source code, and existing context logging systems were not able to log quantitative data on the use of notifications. These limitations open up an area for future research. Logging the use of notifications of a large group of users could make it possible to quantify their effect in more detail. Third, as Socially's notifications were fairly intense (frequent), they can be considered as a somewhat extreme case of mobile notifications. Thus, many participants stopped using notifications after some days. However, the intensity of notifications as the default enabled us to find

results related to user control and experience, which might not have shown with less intense notifications.

VIII. CONCLUSIONS

It is apparent that having enough perceived control over automation-assisted reading of an SNS is essential for a good user experience. Most people who used the mobile notifications reported increased reading of Facebook. However, after using Socially notifications for a while, many were unwilling to receive them and felt the system limited their control too much. Whereas some participants perceived that notifications helped them be better aware of their social surroundings, others noted a decreased interest in Facebook. Having a manual means to control Facebook reading felt more suitable for varied everyday use. We believe that it is valuable for designers to understand that people will practice control over the notification system one way or the other to suit their SNS use purposes. Offering easy-to-use technical ways for the user to adjust the intensity and content of notifications assists the adaptation of the notification system to individual needs. Inaccurate, impractical, or limited technical ways to personify the notification system might make users control them by shutting them down or ignoring notifications completely. In this paper, we suggested design implications for better user experience of mobile notifications. A valuable direction for future work would be to study the best and most convenient ways to ensure that the intensity and value of notifications meets the use practices of an individual SNS user. Considering the rapidly-developing sensing capabilities of modern smartphones, we see activity recognition as an interesting path to study the possibilities of automatically finding the proper contexts for notifications. However, at the same time, the importance of perceived control to a good user experience must be kept in mind in the design process of SNSs.

ACKNOWLEDGMENT

We would like to thank Erkki Kuisma and Hannu Vilpponen from Nokia Research Center for supporting the study, Antti Oulasvirta for support in the early phase of the study design, and Risto Sarvas for comments on the early version of the manuscipt.

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AUTHORS

Sami Vihavainen is with the Aalto University's Helsinki Institute for Information Technology HIIT, P.O. Box 15600, 00076 Aalto, Finland (e-mail: sami.vihavainen@hiit.fi).

Kaisa Väänänen-Vainio-Mattila is with the Tampere University of Technolgy's unit of Human-Centered Technolgy, department of Pervasive Computing, P.O. Box 589, 33101 Tampere, Finland (e-mail: kaisa.vaananen-vainio-mattila@tut.fi).

Sami Vihavainen was supported by the Academy of Finland project AMOVEO and Aalto University's project Otasizzle. Otasizzle project provided the living lab environment. Nokia Research Center also supported the study by providing a smart phone for the researachers to use during the study. Received 22 November 2012. Published as resubmitted by the authors 20 March 2013.

We Want More: Human-Computer Collaboration in Mobile Social Video Remixing of Music Concerts

Sami Vihavainen[1], Sujeet Mate[2], Lassi Seppälä[1], Francesco Cricri[3], Igor D.D. Curcio[2]

[1]Helsinki Institute for Information Technology HIIT / Aalto University
00076 Aalto, Finland
{sami.vihavainen, lassi.seppala}@hiit.fi

[2]Nokia Research Center
P.O. Box 1000, 33721 Tampere, Finland
{sujeet.mate, igor.curcio}@nokia.com

[3]Tampere University of Technology
P.O. Box 527, FI-33101 Tampere, Finland
francesco.cricri@tut.fi

ABSTRACT

Recording and publishing mobile video clips from music concerts is popular. There is a high potential to increase the concert's perceived value when producing video remixes from individual video clips and using them socially. A digital production of a video remix is an interactive process between human and computer. However, it is not clear what the collaboration implications between human and computer are.

We present a case study where we compare the processes and products of manual and automatic mobile video remixing. We provide results from the first systematic real world study of the subject. We draw our observations from a user trial where fans recorded mobile video clips during a rock concert.

The results reveal issues on heterogeneous interests of the stakeholders, unexpected uses of the raw material, the burden of editing, diverse quality requirements, motivations for remixing, the effect of understanding the logic of automation, and the collaborative use of manual and automatic remixing.

Author Keywords: Automation, Video, Human Factors, Music, Social, Mobile.

ACM Classification Keywords: H5.m. Information interfaces and presentation (I.7): Miscellaneous.

General Terms: Human Factors.

INTRODUCTION

Today, more and more consumers utilize their mobile phones for recording video clips and for editing activities. Video features and recording quality of mobile phones are reaching a level where the phones are becoming a serious tool for on-the-move content creators. Making available a large pool of snapshot digital videos taken by the audience in the same concert can result in higher value material than individual video clips. The individual digital video clips can be remixed into compilations that potentially enhance the perceived value of the event, are useful for various stakeholders such as the artists, and the fans of the artists. Remixing can also give the fans the possibility to become creators and not just receivers, and enhance the community feeling between the artists and the fans [11].

Digital video editing is an interactive process between human and computer; depending on how the editing system is designed, the human will do some tasks and the computer will do others. A key issue with designing collaborative multi-camera video remixing systems is the level at which the editing tasks should be automated and thus allocated between human and computer. This is especially important to ensure that the editing process will not feel too troublesome for an amateur and still produce an output that adds perceived value to the stakeholders.

As we will explain in more detail, automation has a high potential to improve the performance and ease the burden of producing a video compilation. However, in a live concert type of social context, where the compilation should be able to reconstruct the collaborative experience between the band and the audience, it is not self-evident how the automatic editing algorithm should be designed.

To approach this problem, we studied the motivations for collaborative video compilations and the role of automation in the process of editing the compilations. We conducted a user-centric real world study to bring out the points of view of various stakeholders and reveal automation related socio-technical factors that we thought could be important to consider in social video remixing systems.

We formulated the following research questions:

- What are the users' motivations for collaborative video compilations?
- How do users react to manual video remixing?
- How do users react to automatic video remixing?

CHI 2011, May 7–12, 2011, Vancouver, BC, Canada.

By publishing a video compilation, the publisher puts the content to a public space (e.g., the Internet), where the stakeholders' different interests might conflict. This is why we see that to create sustainable social video services with an excellent user experience, it is not enough to study the phenomena only from one angle, but instead we must aim for a more heterogeneous view by studying the subject from the point of view of various stakeholders. We therefore studied the two main stakeholders of a live concert event: the artist and artist's fans. Under the word "artists" we include also the artist's record company, agent, and manager. Under "fans", we include people who have great enthusiasm for the artist. We understand that the interests of the actual artist and their record company might sometimes differ in the music industry ecosystem. However, for this study, we saw that the producer-consumer distinction is sufficient. We also researched how the boundaries between consumers and producers would blur when the consumers become producers with automation as a middleman.

As a case, we compare the manual and automatic video editing processes and outcomes from the two stakeholders' perspectives. The video compilations were produced out of video clips that the audience took with camera phones in a live concert. In the manual editing process, we gave the fans of the artist the ability to use the Kaltura video editor to make their own compilations from the raw material. In the automatic editing process, we used a software prototype developed by Nokia (we will refer this as Automatic Video Remixer (AVR)). In a nutshell, this software adds context data to video clips while filming, and is afterwards able to automatically produce compilations from multi-camera video material by using the captured context data.

We begin this paper by presenting the manual and automatic video editing processes as part of our research frame. Next, we present our results on how the stakeholders reacted to the manual and automatic video remixing and how they assessed three collaborative video compilations that were produced as a part of the study. At the end of the paper, we discuss the possibilities and challenges that the automation faces in mobile social video remixing from live music events. As the main data gathering methods, we used a focus group session and individual interviews.

RELATED RESEARCH

Studies on video production and mobile media

Let us start by going through the research related to the artist-audience interaction process. Engström et al. [2] analyzed how dance club's video jockeys work and suggested that mobile video could enhance the interaction between the club visitors and VJs. Engström et al. [1] continued their studies and presented the SwarmCam prototype for video capture and live transmission of mobile video. Club visitors film their dancing on the dance floor and stream the video live to the VJ, who possibly broadcasts it to a mega screen. From our paper's point of view the study is interesting, given that it concentrates on the interaction process of VJ and club visitors in often so dark music clubs. In our study the context is similar, focusing on the improvement of the interaction between the artist and audience, but in stretching the timeline of the experience with post event video remixing.

Foote et al. [3] and Kennedy et al. [8] concentrated on automation in video remixing. Foote et al. [3] concentrate on automatic analysis of audio and video material based on significant audio changes, automatic suitability analysis of the video based on camera motion and exposure. Their system then stitches audio and video material together so that high quality video clips are adjusted to match the audio segments. They also developed a semi automatic system (Hitchcock), where the user manually selects the preferred video clips and the system automatically synchronizes the video clips with the audio track. This is a very interesting study not only because of the automatic content analysis but also because it takes into account the collaboration between computer and human for easy production of personalized video compilations. Kennedy et al. [8] studied automatic video synchronization and organization of video content taken by the audience in live music concert contexts. Their results reveal practical points regarding: use of audio fingerprinting to synchronize videos taken at the same event, the effectiveness of audio synchronization under different conditions, and finding meaningful content-based metadata to retrieve and summarize video material.

Girgensohn et al. [4] describe their video remixing system Hitchcock that was also discussed in Foote et al. [3]. The system takes a semi-automatic approach on creating custom videos from raw videos taken by a basic home video camera. In their paper they concentrate in home videos and not music videos. The system analyzes video content based on the camera motion and gives the video material unsuitability scores. The work is interesting considering the focus on various levels of automation. Girgensohn et al. [5] present their user study on Hitchcock. Their results demonstrate the need for a useful balance between user control and automation. Kirk et al. [9] take a holistic user-centric view on people's practices around home videos. Their results reveal useful information about people's motivations and practices for editing home videos. One of their results is that people do not find any reason to do editing of the short video clips they had taken. Shamma et al. [14] suggested that multimedia research should shift from semantics to pragmatics by designing systems and algorithms that can usefully utilize information about how media content is being used in specific contexts. Lehmuskallio et al. [10] studied people's snapshot videography practices. They state that the models for capturing video are often taken from snapshot photography.

In addition to video editing and practices, there is related research on mobile content creation, for example Jacucci et al. [6] and Sarvas et al. [13], and on automation in mobile social applications, Vihavainen et al. [16].

Video editing, multi-camera video production, music videos, automation, live contexts, or user point of view have been discussed in several high-class studies. However, none of the earlier studies have combined those aspects in a single study. Also our objective is to take into account the viewpoints of various stakeholders that interact in the production of collaborative music video compilations.

Automation as Part of Human Factors Research

Automation has been studied systematically in human factors engineering. Sheridan [15] proposed an automation framework with seven levels:

1. The computer offers no assistance; the human must do it all
2. The computer suggests alternative ways to do the task
3. The computer selects one way to do the task and asks for human approval
4. The computer allows the human a restricted time to veto before automatic execution
5. The computer executes the suggestion automatically, then informs the human
6. The computer executes the suggestion automatically, and informs the human if asked
7. The computer selects the method, executes the task, and ignores the human.

Table 1. Levels of automation according to Sheridan [15]

In addition, Parasuraman et al. [12] proposed a four-stage model of functions inside the system that can be automated on different levels:

1. Information acquisition	3. Decision selection
2. Information analysis	4. Action implementation

Table 2. Stages of automation according to Parasuraman [12]

These levels and functions make an automation design matrix that we believe might be useful in examining the human-automation collaboration in mobile video remixing.

THE STUDY: 11 FANS IN A ROCK CONCERT

Users from two stakeholder groups (artists and fans) were recruited in Finland to participate in the study. A focus group session and a user trial (with interviews) were conducted to discover opinions, reactions, and experiences on social video production from live music concerts.

Users

The artists (Artists) who represented the artist stakeholders included the three members of a Finnish rock band and four employees from their record agency (The Artists will be marked as A1…A7). Three of the artists (A1, A2, A3) had a background in movie editing, and all were professionals in the music business. All were men, age 25 to 35. The fans (Fans) were a group of eight men and four women living in southern Finland (The Fans will be marked as F1…F12). All were between the ages of 18 and 30, with one 61-year-old man (F3). Two of the Fans (F2, F4) had an amateur background in movie editing and two had a strong background in amateur photography (F3, F12). Others were not particularly tech savvy. Most were hard-core fans of the band. They were recruited through the band's Facebook profiles and newsletters. All were interested in going to music concerts and took photos or video during concerts to get memorabilia and share experiences with their friends.

Data Collection

Focus Group Session

The objective was to discover the Artists' and the Fans' views, opinions, and habits concerning video recording at live concerts and remixing the recorded video material afterwards into compilations, either automatically by a computer or manually by the users. Four participants from the Artists (A1, A3, A6, A7) and seven from the Fans (F1, F2, F3, F5, F6, F7, F12) participated in the focus group.

User Trial

As a user trial, we arranged a live rock concert in collaboration with the band (A3, A6, A5) and their record agency (A4). The concert was a public event and thereby an authentic situation. 11 of the Fans (F1-F11) participated in the trial. They were given Nokia N97 phones equipped with the context-recording client that was used as part of the automatic remixing process (we will present the manual and automatic remixing processes in the next chapter). The Fans were directed to film as they would normally do in the concert situation. However, they were told that from the raw material, both automatic and manual video compilations would be made afterwards. For technical reasons (mainly battery life), they were directed to film a maximum of 15 minutes, and the maximum length of a clip was five minutes. After the concert, the phones were collected and users were provided with access to the raw video material and the Kaltura video editor (Kaltura will be presented later).

Interviews

After the trial, six of the 11 Fans (F1-F6) who participated in the trial and three of the Artists (A1-A3) were interviewed. The interviewees were selected based on voluntariness. Before the interviews, both the manually and automatically created remixes had been made available for viewing. The interview protocol was semi-structured. During the interview, we showed the participants one manually made reference compilation that was made by us, one of the manual compilations made by F1, and one automatic remix that was made using the AVR automatic remixing system. We watched the compilations with each of the participants and let them comment on the videos. After each video, we asked whether they thought the compilation was made by a human or a machine, and asked their feelings and opinions on the compilations and the remixing processes. Six out of eight participants had not seen the compilations before the interview and did not know whether the

compilations were made manually by a human or automatically by a machine. For this paper some of the quotes from the transcriptions of the interviews and the focus group were translated into English by the first author.

The Video Remixing Procedures

Next we address the trial procedure — including the automatic and manual video remixing procedures — that we used as a research frame in our study. Figure 1 shows the remixing process we utilized in our user trial.

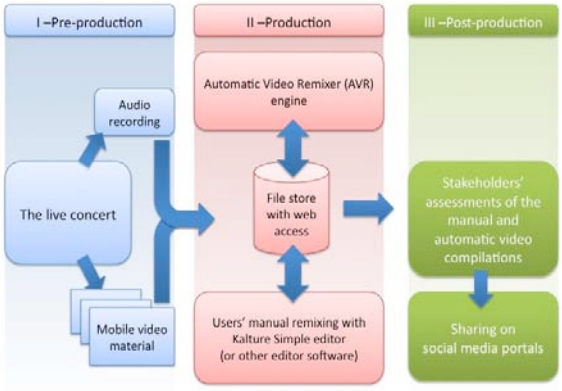

Figure 1. Remixing process

Automatic Remixing System

The automatic remixing system consists of the recording devices and a remixing server, and it functions in three main stages. The first is the *Pre-Production* stage, the second the *Production* stage, and the third the *Post-Production* stage.

The *Pre-Production* stage consists of recording the videos at the music event, and subsequently uploading these to the automatic remixing server. The recording devices (Nokia N97 mobile phones) were running a context recording client simultaneously with the video recorder. The context recording client captures and stores time-stamped sensor data while recording the videos. This helps in inferring the contextual information of the recorded video depending on the sensors being used. For the trial, data from the built-in electronic compass was recorded together with the video. The electronic compass gives as output the orientation of the camera-pointing direction with respect to North (for example: 90 degrees with respect to North). The information about the orientation of recording is then exploited to achieve two main goals: understanding what is the Region Of Interest (ROI) of the event for those users who are participating at the multi-user event recording, and inferring horizontal and rotational camera movements (also known as "camera panning" operations). Due to the limited network bandwidth availability with respect to the high volume of recorded data, we chose not to have direct uploading from the mobile phones. Instead, the videos and the context data were uploaded offline using a USB connection.

The *Production* stage is based on the idea of stitching together video segments cropped from the original source videos recorded by different users. The main issue consists of understanding which video segments to consider and discovering the optimal length for each of the selected segments. The *Production* stage consists of several steps. First, all the uploaded videos are synchronized with each other such that the same events happen at corresponding timestamps among different user recorded videos (i.e., source videos) which overlap temporally. The second step consists of context data analysis: the orientation data from each user is used to infer if and when that specific user has moved the camera phone in a horizontal direction by means of a panning operation. The detected panning operations are then marked as "event points" and used in the AVR video generation as switching points between different views. Also, orientation data from all the users is used to understand if there is a specific ROI in that event. The information about the ROI is then used to assign higher priority to videos that have been recorded by pointing the camera phone within the range of orientations of interest. The video segments with higher priority will then have a higher chance of being inserted into the final AVR video. In order not to switch from one view to another too fast or too slow (causing an unpleasant viewing experience), minimum and maximum segment durations (lower and upper bound temporal thresholds) have been set in the process. Thus, if there are consecutive event points detected within a too short time interval (i.e., less than the lower-bound temporal threshold), only the first event point is used for switching the view. Instead, if there are no event points for a too long interval (depending on the higher-bound temporal threshold), then the system forces a view switch. After having stitched together all the selected video segments, the visual part of the AVR video is ready. Regarding the audio side, a combined audio track is created by using the extracted audio from the recorded videos. The approach for this combined audio track creation is based on two requirements: using the audio tracks with the best quality, and obtaining the minimum number of audio switches. The first requirement might introduce a large number of audio segments if the source content consists of frequently changing audio quality or many source videos with good audio quality of short duration. Thus, there has to be a trade-off between the requirements. At this point, the automatically generated video and audio tracks are merged to obtain the final AVR video.

The *Post-Production* stage includes the sharing and viewing of the AVR video. Due to the completely automatic nature of the AVR production, there is a possibility for inclusion of source videos that contain objectionable material (e.g. obscene gestures). When such segments are included, the related source video needs to be removed manually.

Manual Remixing Procedure

The manual remixing procedure roughly simulates the way a single user would preview, download, upload, and remix mobile video material that is accessible on the web. The procedure follows the three phases as described before for the automatic remixes and as shown in Figure 1, but differs

in the Production phase. In this phase the Fans were provided with a link to a website with previews of the videos as well as access to download the raw material, including a fifteen minute audio track recorded with the Nokia N97 or three specific audio tracks recorded with a video capable micro-DSLR camera. Users could watch the lower quality preview videos and then download all or part of the material in the original quality. The Kaltura Open Source video platform [7] was used to provide users with an online video editing service for creating mixes from the downloaded material. Kaltura was given only as an option and not as a mandatory requirement. All the participants were also instructed that they could use some desktop-based video editor if they desired. We wanted to offer them one tool because many of them did not have earlier experience on video remixing. With Kaltura it was easy to give technical support, if needed. Kaltura Simple Editor provides the basic video editing features needed for mixing together multiple video clips and a soundtrack; it includes timeline-based editing, trimming of and transitions between video clips, and options to use either video clip audio or an external sound file. The editor was used online on a web browser and required users to upload all the material they wanted to use in their mixes. After uploading the material, it was converted on the server to a format usable by the editor. The necessary conversion process added more waiting time on top of the time used for uploading the material. This, however, simulates the fully manual remixing process as was intended. After conversion the videos were available in the editor's Clip Library tab where the clips could be dragged onto the timeline. On the timeline the clips could be trimmed to a desired length and transitions could be added in between the clips by dragging them onto the timeline from the Transitions tab. In the Soundtrack tab the user could upload sound files into the project. One single sound file could be used to play over the video, either in looped or play-once mode. Users could then choose to mute the sounds from the videos to have them to play together with the selected soundtrack or without a separate soundtrack.

Overview of the Data

Raw Material

The trial resulted in 105 clips, totaling approximately one hour and 52 minutes of video and 2.3GB of data. Each user contributed an average of nine clips. There was a wide variation among the users on the number of clips with the minimum being four clips per user and the maximum being 20 clips per user. There was no direct correlation observed between the number of clips per user and the average clip duration. Some users were more prolific than others; the minimum total time of the clips recorded per user was 4:39 while the maximum total time of the clips recorded per user was 12:24. The maximum clip duration for each user varied between one minute and five minutes. Of these, the users chose not to include seven videos for remixing; thus, the total time of the clips was approximately one hour and 44 minutes. Most users wanted to include all of the material they shot. Three of the four users who decided not to include some videos excluded more than one clip.

Video Compilations

Out of the Fans who participated in the concert trial, only one, F1, edited her own video compilations. She made two of them. As a reference, we made a reference remix using the same process and editor as described earlier. It was done to test the process and the capabilities of the editor fully, to give an example of certain kind of editing style, and to test how it will be assessed against the other compilations. With the AVR system, we made two compilations to test what kind of compilations the system makes from the material that is taken in an authentic music concert environment.

FINDINGS 1: GENERAL REQUIREMENTS FOR REMIXES

In the focus group and the after-trial interviews, our objective was to discover the stakeholders' requirements for the collaborative video compilation process and their views on the added value of manual and automatic social video compilations from a live music event.

Heterogeneous Motivations for Video Compilations

The Fans' main motivation was to record videos as personal memorabilia of the concert. However, some people said that they share video clips with their friends, for example, on Facebook. Others noted that they would share the videos more with their friends if they could do it easily from their phones or cameras during the event. The Artists thought that video compilations are a way to promote the band image, and could be used by venue owners to publicize the band. The main motivation was to demonstrate the interaction between the band and the audience to other people who did not see the event live.

> "As an agent, it is very important to me to show the customers [venue owners and consumers] how the band's live performance looks like." – A1

Both the Fans and the Artists saw video compilations as a great way to enhance the concert experience, stretch the timeline of the concert, and promote interaction between the fans and the band.

> "To get the fans to communicate with each other. That is why this is interesting." –A1

> "After a concert I often have a feeling like, too bad it's already over." – F1

FINDINGS 2: REACTIONS TO MANUAL REMIXING

In this section, we describe the reactions of the stakeholders to the manual remixing, including how they felt about making compilations and what kind of motivations they had to make their own.

Motivations for Manual Mixing

For the Fans, the main motivation to make their own manual compilations was personal challenge, and/or publication (such as to the band's Facebook profile).

"I Made This!" Self-Expression and Meeting a Challenge

The F1 who made two manual compilations was very motivated. She was proud of her compilations and excited at the prospect of them being published somewhere.

> "I had this kind of proud feeling that this is my thing . . . then I can say that, hey I made this!" - F1

She felt successful after completing difficult editing of her clips to suit herself.

> "Then it was like, great, I got this one thing done!" - F1

She was also motivated to make more compilations. However, she was not sure if any band would like to use these kinds of mixes because they are not very professional. One of the Fans did not consider publication important, and he felt that the only motivation was the personal challenge and that he could make something nice for himself.

> "It would be like, hey I made this!" – F2

However, he would have agreed with the publishing of his compilation on the band's Facebook site.

F4 was motivated to make a remix. He even had planned what kind of a story he would tell with his remix. However, he had some problems with his Internet connection and in understanding the logic of the manual remixing process. He liked the idea of getting his remixes published.

"Not Interested!" Concentrating on the Concert and Not Video Editing

For the F3 and F2 it was all about the concert experience itself. They did not have any interest in making compilations of their own. Their primary intention was just to shoot the video material in the concert and give it to other people to make the remix. They did not feel that remixing was for them.

> "I shoot the material and give it to others." – F3

Burden of Manual Remixing

Next, we will discuss the burdens involved the manual video compilation.

"It's a Tough Job But I Love it": Overcoming the Hardship and Keeping the Standards High

The F1 who made her own compilations said that for the first one (duration of 4:24), she worked about 35 to 40 hours. This was a surprisingly long time considering that the reference compilation our researcher made was completed in about three hours. F1 said that first she used one evening to familiarize herself with the Kaltura video editor. This was evident because she did not have any video editing experience. Subsequently, after 12 to 14 hours of editing, she thought the compilation was ready. However, she was still not satisfied.

> "I wanted the remix to be perfect." – F1

She also went through almost all of the raw material of one song. She made a choice to concentrate only on the video material from one song; otherwise the work would have been too much. This demonstrates how laborious and time-consuming it can be for an amateur to manually make a satisfactory video compilation.

"I Was Going to Do it But Something Came Up": No Time and Technical Difficulties

The other three of the Fans (F2, F4, F5) who had some intentions to make their own manual compilations said that they either did not have time for it, or they felt it was too much of a burden to start figuring out how the editor worked and going through the raw material. There was also a technical difficulty in getting their computers to view the material and upload the best videos to the Kaltura editor.

> "It was like download clips to the computer, upload clips to the server. Edit there, put here. I was like, later!" – F2

F4's home Internet connection was so slow that he was unable to download the raw clips to his computer. He was also uncertain if he understood how to proceed with a manual compilation:

> "It was a little uncertain for me, how to make the remix." – F4

"No Way I'm Going to Do This": Way Too Much of a Burden

Two of the Fans (F3, F6) did not even check the manual editor and had no intention to do their own compilations. F6 said she would just forget herself while trying. She also had some problems in understanding the logic of the editing process. The M3 did not even check how Kaltura works and had no intention of making a compilation of his own.

> "I just did not feel like studying it." – F3

FINDINGS 3: USE OF THE MANUAL EDITOR

In this section, we will discuss how the manual editor was used. Our data comes from the F1 who made her own video compilations, and the findings are based on her experiences. We still think there are valuable results relating to how an amateur can make multi-camera live music video compilations manually, and what significant factors there are in that kind of video editing process.

Unexpected Uses of Raw Material

Manual editing brought up some unexpected uses of the raw material, like use of lights, jumping audio track, and ruined video material. The F1 said that she used lights as a guide to edit the remix. Beforehand, we thought that the music would be the main factor when the user chooses when to make cuts.

> "In addition to music I used lights as a guide to edit the remix. ...Because they changed in convenient points." – F1

She did not use the complete audio track that we provided. However, her idea was not to make a music video style remix with a complete audio track but something different. She thought that it was "cool" to listen to the concert from several places. She also wanted to use all the possible camera angles. Her intention was to show the viewer how

the concert looked and sounded from various places in the concert hall, and to show that the experience is different depending on the location. Because of this she tried to use every participant's material for her remix:

> "I wanted to add in the element that shows how the concert sounds when you are at the balcony, near the drums or at the back of the hall." – F1

She also wanted to use a clip where the cameraman had flipped the phone by 90 degrees. She thought that would be a great special effect. The fan who had recorded that exact clip thought that the clip itself was ruined because he had accidentally held the camera with a wrong angle. We think this is a great example of how an individual video clip has much more potential when it can be remixed innovatively with other video clips.

Coping With the Amount of Raw Data in Manual Mixing

We were surprised of how fast can the raw material grow in a multi-camera recording. F1 had to mark off some material in the beginning so that going through the clips would not be too overwhelming. She decided to concentrate only on the clips from one song. Although she tried to use every participant's material for her compilation, she used her own material the most. This was mainly because she was familiar with it, and it was laborious to find good scenes from the other cameramen's raw material manually. She also used pen and paper to keep notes about which of the clips were good. It became clear that the amount of a multi-camera video material quickly becomes so large that it might be overwhelming to go through all the video material manually. As one of the Artists said:

> "If one has material from 100 cameras there is no way he can go through all of them…Even if one had four cameras and a web based video editor, there are still endless ways one can go wrong and concentrate on insignificants thing during the first five seconds of the editing process." – A2

Thus, for example efficient use of metadata or more strictly organized directing in the filming phase might make it easier for an amateur to handle the material and make manual video compilations.

FINDINGS 4: REACTIONS TO THE MANUAL REMIXES

In this section, we will go through the participants' reactions to the manual compilations.

The Reference Compilation

Five of the six participants guessed that humans made the reference compilation, and one was unsure. Based on the interviews, the five knew the video was human-made because it seemed somehow logical; the change of colors worked effectively; cuts were synchronized with the music; and it had "a human touch."

> "It was made from the short cuts and what was special about it was the rhythm. The creator gave the viewer an understanding about what is going on [in each scene] and then it was cut to another scene and cut and another and cut…" – F3

All of the Fans thought that the reference compilation was good, and many of them were amazed how it was possible to make such a good compilation from the raw material they had been filming. The Artists had positive feeling towards the video and thought that it might be good publicity for the band. They thought that it might be the deciding factor a wavering concertgoer.

> "I think and hope that based on this compilation a positive twist could happen" – A3

The Manual Compilation Made by One of the Fans

In the case of the manual compilation made by F1, the participants were a bit unsure whether it was made manually or automatically. Still, five out of six participants thought a human made it. The main reason for their uncertainty was that this compilation did not have a continuous audio track, but instead the audio was from the individual scenes' audio. This made the audio fragmented and negatively affected the viewing experience. However, the clear narration convinced them it was human-made. In the first scene, the band's lead singer welcomes people to the concert, and in the last scene, he walks away, jumping and waving. This gave the users a human impression.

FINDINGS 5: REACTIONS TO AUTOMATIC REMIXING

In this section, we will discuss how the users understood the logic of automation, reacted to automatic compilations, and what kind of use they had in mind for automatic remixing. Before the trial, the participants' first reactions to automatic remixing were mostly curious about how it would work and how the machine makes decisions. Many of the participants also thought it sounded interesting that a machine could do the editing process, but also brought up that they felt a bit skeptical about how it could be possible.

The Effect of Understanding the Logic of Automation

In the trial, the participants were not told how the automatic editor makes decisions and what information it uses in the editing process. This enabled us to study the effect of understanding the logic of the automatic editor, especially how the ignorance of the logic of automation affects how the Fans film in the concert situation. Some of the Fans thought that the automatic editor would not be able to cut the raw clips in any way. Because of this, they tried to shoot short, ready-to-use clips.

> "Because it does not cut those (raw clips), because there is going to be the whole clip. That's how I assumed it works." – F4

The F3 thought it was bothersome to shoot the video clips because he did not know how the automatic systems made editing decisions.

> "One should know what their algorithm is like." – F3

The Fans were thinking about the editing phase already as they shot. They tried to cooperate with the automatic editor by pre-planning what kind of material would be useful.

Reactions to the Automatic Remix

Five participants' thought the compilation was automatically edited, and one was unsure. Thus, it was clear that the automatic compilation had special features that made it look like machine-made. Next, we will discuss what those features were and how the participants reacted to the automatic compilation before and after they came to know that it was automatically edited.

"This Does Not Have a Rhythm": Reactions Before Knowing it Was Made by a Machine

Because of the low light conditions in the concert hall, there were many dark scenes in the raw material. Thus, all the compilations, manual and automatic, had dark scenes. However, in the automatic compilation, participants thought the darkness was somehow "weird" and that it flattened the feeling of the video.

> "This darkness does not motivate here. It does not have any function here." – F3

None of the participants liked the automatic compilation as much as they did the first two manual ones. The automatic compilation was described as passive.

> "Passivity can be a special effect to bring up dynamic stage performance. But in this there is only darkness." – F3

"Not So Bad After All, But No Use as a Promotional Material" – Reactions After Knowing it Was Made by a Machine

When the Fans were told that the compilation was automatically edited, most of them then developed a different perspective. Even though it lacked the human touch, it was still viewed positively. It seemed that people did not have such high expectations for the machine-made compilation.

> "It's actually good considering it's a machine made" – F4

Most of the participants saw the automatic compilation as promising and said it would be worth developing further. However, the Artists especially still saw limitations. They brought up how it is hard to get a good automatic compilation because editing is based on continuity of movement, colors, and music that enables a narration.

> "It's impossible to automate drama." – A2

The Artists also thought that the image the automatic compilation projected about the atmosphere of the live show was so irrational that if it was the only reference to the band's live performance, the fans would not come to watch.

> "The machine is irrational. When there is action on the stage, it shows only an illuminated exit sign." – A1

The Perceived Usefulness of the Automatic Compilation

Although the automatic compilation did not get very high ratings from the participants, many of them still found situations where it could be useful, especially if it could be made more interesting. Some of the Fans thought that the automatic one could be used in personal blogs or for marketing, and could be an easy way to participate without having to make their own manual compilations.

> "You can take video and then you become part of this compilation. It would be participatory activity" – F1

> "Like I could watch it from YouTube." – F4

The F4 also thought the automatic remix would be great to have on his mobile phone right after the concert. This would extend the timeline of the concert experience and would be great memorabilia produced with no effort, even if it were not top quality.

How to Make it More Interesting

Next, we asked the participants how to make the automatic compilation more interesting to watch and more useful. The main things were that the video should be synchronized with the music; clips should be shorter; there should be more variability in field size; and the dark scenes should be eliminated. Three participants said that the video should be more synchronized with the music.

> "Now the automatic one jumped randomly somehow in a way that a human made one would not." – A3

Two participants said that the compilation should not have such long, continuous scenes from the same camera but instead it would be more interesting and lively if there were quicker changes between cameras.

> "One has to remember that five seconds in a video compilation like that is a long time." – A3

Three participants mentioned that in a multi-camera compilation, there should be more systematic variation in the camera angles and field sizes. They also suggested that there should be scenes from locations other than the main concert hall, such as a bar or the men's restroom.

> "Like Big Brother in a good way." – A3

One of the Artists thought that one reason the manual compilation was better is that a human can use light as a guideline to capture the feeling of the concert. Thus, if the dark scenes could be eliminated, it might improve the viewing experience of the automatic compilations.

> "In a concert the light can change dramatically only for like half second. If you don't capture those tiny moments one might think that the concert was totally black." – A3

Need for Human Intervention

The users often mentioned the need for human intervention as a part of the automatic editing process. A3 said that when he watched the automatic compilation, he had a feeling that he would like to make his own changes to it.

> "I was like I wish I could now go there and edit that. Then one could get more out of it." – A3

He also thought that because the editing process requires a complete view of the raw material, it is difficult to leave it solely to a computer.

> "There has to be a human understanding about what kind of scenes need to be one after the other because contiguous scenes affect to each other." – A3

However, one of the Artists also brought up the importance of the actual goal of the compilations:

> "If it's just harsh recording, it could work without a single cut. However, if we want to do even a little bit artistic material then there needs to be a human in the process." – A2

DISCUSSION

The study showed that in production of social video compilations from live music events it is not self-evident how to allocate the remixing tasks between human and machine.

In a fully manual setup, the user has total control of the editing process. She has the authority from the beginning to the end to sense, analyze, decide, and implement which parts of the material she uses. At best, this flexibility can give a satisfactory feeling to the users. Also, the actual video compilation can raise excitement among the other stakeholders. However, the editing process itself may prove to be troublesome. In multi-camera video editing it can be laborious to manage large amounts of material in a satisfactory way. The use of technical infrastructure for video editing can be felt as too much of a burden to even start the editing. Improvements in the manual editing interface and usability design can only reduce part of the work. The labor of going through the video clips to find the good ones and synchronizing them would still be needed.

By contrast, when the remixing process is fully automated to the point that the computer ignores the human and acts autonomously, humans do not have to do anything but film the raw material during the concert. Thus, the laborious struggle with the technology and the burden of perusing the overwhelming quantity of material disappears. However, it turned out that a machine simply cannot imitate the human touch. It was surprising that ignorance regarding the logic of the automatic editor had an effect on how the people filmed the video during the concert. People made assumptions about how the machine would edit the raw material and directed their filming based on those assumptions. We also found out that expectations for an automatically made video compilation versus the manual one were lower. Naturally, how satisfactory a video compilation is perceived to be depends on its intended use. We found that for a documentary style compilation, the artistic demands are muted. On the other hand, a compilation that has to mediate the social interaction and atmosphere of a live music concert and is also intended to be used for marketing purposes has very stringent demands in terms of artistic quality.

Our research frame considered the two most extreme options of automation: namely, fully manual and fully automatic. We note that there is a large design space between those two extremes; a space where human and machine can collaborate in various stages during the remixing process, depending on how personal and artistic one wants the compilation at one extreme or how simple and fast at the other. For this design space, we propose that designers use the levels of automation and the stages of information processing Sheridan [15] and Parasuraman [12] have presented, and which we discussed earlier in the Related Research section.

As an example, let us next walk through a case where we set the tasks of a video remixing process into Parasuraman's four-stage model of information processing and discuss how Sheridan's automation levels could change inside the video remixing process when moving from one stage to another. Thus, we stress the use of human labor in some tasks and machine labor in others. In *the first stage*, information acquisition can cover the sensing of the raw data. If the goal is to find all scenes that have bright lighting conditions, in a fully manual model, the human must go through the material and find the proper scenes. As we have discussed, this is laborious with multi-camera material. However, if we raise the level of automation and program the machine to sense and "lock on" to all the bright scenes, this would ease the human labor. In *the second stage*, information analysis can cover the cognitive functions such as remembering which of the previously found bright scenes also include a guitar solo. In a fully manual setup, the human must manually integrate the two inputs (the brightness and guitar solo) and analyze when they both exist together. If we raise the automation level and let the computer do the analysis, we can ease human labor by letting the computer provide context-dependent summaries of the raw video data. During *the third stage*, the decision and action selection stage, some of the previously found scenes (with good lighting conditions and a guitar solo) are selected to be stitched in a particular order into a compilation. This stage could be left for human to do independently, and this is a way to raise the artistic value of the video. In *the fourth stage*, the actual stitching phase is implemented during which the selected scenes are stitched together, forming the final compilation. Human could implement this step by manually combining the previously selected scenes. If the fourth stage was automated to a higher level, a computer could execute the stitching autonomously and complete the editing process.

By this thought experiment we want to demonstrate the possibilities of dividing the video editing process into separate information-processing stages, and by that help designers and developers to systematically think of an automated process in multi-camera video remixing. When moving from one stage to another, it is possible to change the level of automation depending on the intended uses for the compilation. If the need is to get a quick documentary style compilation, greater emphasis should be put on automation. However, if the need is for an artistic compilation, higher human involvement may be required.

CONCLUSIONS AND FUTURE RESEARCH

We compared the processes of manual and automatic video remixing from both the artists' and the fans' point of view. We studied the process from the moment when the fans shoot mobile video in a live concert to the moment when the fans and the artists assess the human or machine made video

compilations. Based on the results, automation related design decisions have several implications on the motivations and reactions the users have towards a collaborative mobile video remixing system and the actual video compilations.

First, it came up that the various stakeholders of a music event could have different motivations and requirements for video compilations depending on the intended use. An artist might want to emphasize the marketing value of the compilation whereas a fan might want to have it as personal memorabilia for her to share it with friends. If the compilation is wanted to have a special artistic feeling, it is hard to gain that with a fully automatic remixing. *Second,* the manual editing process can give satisfactory results but the raw material from multi-camera video shooting can quickly become cumbersome. This came up when only one of the participants made the effort to actually make video compilations. She did a lot of work for them but in the end was very satisfied about the results. *Third,* people are able to use the raw material innovatively in ways that are difficult for computers to imitate without a high-end adaptive automation. For example, video material that was accidentally shot with a 90 degrees angle was surprisingly considered as a great special effect material. *Fourth,* automatic video compilations are not assessed with the same criteria applied to human made ones. However, for this to be true, it should be evident to the viewer that a machine has generated the compilation automatically. In our study many participants thought that the automatic video compilations we showed them were quite all right only after we told them that they were remixed automatically. *Fifth*, the results revealed strong interconnections between the filming process and the editing process. Transparency and communication between both of the processes affects the automatic and manual video compilations. For example, knowledge of the logic of the automatic editing process affected the participants' filming process. People were keen to learn the logic of the automatic editing process. Before the filming stage some of the participants had made assumptions on how the automatic remixer would work and directed their filming based on those assumptions. In the manual editing stage, the effect of transparency and communication became visible when a participant ended up using her own video material more than other participants' material. The main reason was that she was more familiar with her own material than with others'. This showed that context metadata the camera phone possibly adds to the raw material, such as location, could be valuable not only in automatic remixing but also for manual remixing. For the future research we believe it is valuable to study the possibilities of automatic and user generated metadata in multi camera video remixing process and how the direction during the shooting phase affects the editing process.

ACKNOWLEDGMENTS

The work was part of Social Video project funded by The Finnish Funding Agency for Technology and Innovation. We thank the participants, Anu Kankainen, and anonymous reviewers for their help and valuable comments.

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Video as Memorabilia: User Needs for Collaborative Automatic Mobile Video Production

Sami Vihavainen[1], Sujeet Mate[2], Lassi Liikkanen[1], Igor D.D. Curcio[2]
[1]Helsinki Institute for Information Technology HIIT, Aalto University, P.O.Box 19215, 00076 Aalto, Finland
{sami.vihavainen, lassi.liikkanen}@hiit.fi
[2]Nokia Research Center P.O. Box 1000, 33721 Tampere, Finland
{sujeet.mate, igor.curcio}@nokia.com

ABSTRACT
Digital memorabilia, such as video remixes, can increase the value of attending music events. Remixes can be made using video clips recorded by attendees during the event; however, producing them is a laborious task. In this paper we study the prospects of automatic video remixing and present the results of a study on users' perceptions and attitudes towards collaborative automatic mobile video production. The three findings are as follows: People assess automatic video remix memorabilia as fairly equal to amateur-made manual ones, even if the manually-created video remixes are better in overall quality; as a remixing actor, a computer can be perceived to be more trustworthy than a human remixer; and, the quality of the video remix and the publication forum of the remix outcome plays a significant role when people are deciding whether or not they need public acknowledgement for their contribution. We conclude by discussing the design implications for collaborative automatic mobile video production.

Author Keywords
Mobile video; CSCW; live music; memorabilia; authorship; crowdsourced media

ACM Classification Keywords
H.5.1 [Information Interfaces And Presentation]: Multimedia Information Systems - Evaluation/methodology;

General Terms
Design

INTRODUCTION
Live music events are one of the most important sources of revenue for artists. Many people invest considerable time, effort, and money to attend live performances. Different types of artist memorabilia from concerts provide added value for music consumers. Technology facilitates this process; nowadays it has become common for the audience to capture video clips and photos with smartphones during live music performances. This trend produces a pool of underutilized material that could become part of video remixes that combine material from several points-of-view to create novel memorabilia, thus enhancing the experience. However, producing multi-camera video remixes is laborious due to material handling and the number of people involved. Previous research shows that automating the editing process can ease the burden of remixing [13], but this requires human-produced video material to edit. Users must also be willing to hand over their personally-recorded footage to the automatic system.

This study aims to provide design insights to the CHI community for building collaborative video production tools. We believe the insights can be valuable also to video or photography services for large-scale events in general. Through our earlier study with an automatic video remixer [13], three issues emerged. It was unknown how potential users would perceive automatic video remixing systems in terms of *personal value*, *need for control* and *public acknowledgement*. By *personal value,* we mean how useful people perceive the mobile video remixes as memorabilia. Previous research has shown the importance of visual media for reliving an event [1,7]. Also more broadly, mobile media plays a major role in attendees' active construction of a shared experience at large-scale events like music festivals [6]. By *need for control* we mean the level of control that people desire when contributing personal video content to be remixed by an automatic video remixing system. Previous research has shown that too much automation with too little user control may affect the perceived usefulness of the system [11] and cause withdrawal [12]. By *public acknowledgement,* we mean peoples' attitudes about being publicly acknowledged if their clips were used in the remix. Previous research has shown that in remixing culture, acknowledgement plays a significant role in the negotiation of rights to use material [4, 10, 9].

METHODS
We arranged a two-day field trial at Provinssirock music festival in Finland during summer 2010. We collaborated with two of the performing rock bands and recruited 51 festival attendees to take mobile video clips during two concerts. A real-world trial was conducted to ascertain user attitudes based on experiences in the context for which the system was designed. We recruited 22 users via the bands' Facebook sites and 29 on-site. All recruits were young adults, no minors. The participants were given Nokia smartphones for the task. They formed groups of three to

five people and were instructed to record video clips during the concerts. They were told that, after the festival, all the video clips would be used as material for video remixes produced by the Nokia's automatic video remixer system (AVRS); their material also would be made available for video remixing using a web-based video editor called Jaycut [5]. After the event, we encouraged the participants over email to create video remixes. All together, four automatic and six user-generated video remixes were made. After receiving the artists' permission, we published eight of them on YouTube (two automatic and six manual) to give them visibility.

We invited the participants to complete a web-based questionnaire, which also included links to five of the YouTube remixes (two automatic and three manual). The questionnaire asked: How do people perceive automatic remixes as memorabilia? How do people perceive the sharing of personal video with an AVRS compared to the music artist or an unknown peer as the editor? What kind of attitudes do people have about receiving public acknowledgment for contributing their videos? We compared the automatic system with the two human actors (Artist and Peer) to ascertain if there were dimensions other than human vs. automation in terms of how people perceive the remixing actors. "Artist" here includes all representatives of the artist (e.g. the record company).

The automatic video remixing system

The AVRS utilizes context data from multiple sensors, including a compass, GPS, and an accelerometer. The availability of these sensors is becoming increasingly common on mobile devices. The multiple modalities of context data, which is obtained from these sensors, is stored as time-stamped data while the video recording is in progress. AVRS is critical to generate memorabilia for events. Since the initial version [13], the AVRS was improved to include interesting happenings and information from the live music event, thus adding to the video remix's value as memorabilia. This information is enabled by analysis of context data jointly with the recorded videos, contributed by the users attending the event [3]. This data is used to determine interesting occurrences, perspectives and high quality media segments; which are then included in the video remix [2, 3]. The higher the number of video clips contributed and the greater the number of users contributing clips, the higher the probability of capturing interesting occurrences from the event. Such capturing has the capacity to fill in the experience gap of an individual's video recordings providing added value to the experience. Such added value signifies the high importance one must assign to designing the AVRS in a way that reassures that users' content and identities will be used properly and respectfully.

Questionnaire

The questionnaire contained open-ended and order-ranking questions on a Likert scale (1='strongly disagree', 5='strongly agree'). In the analysis, the scale was simplified by combining the 'strongly agree' and 'agree', and 'strongly disagree' and 'disagree' into two categories, resulting in a one- to three-point scale (1='disagree', 2='nor agree or disagree', 3='agree'). The questionnaire was pretested with eight researchers.

In the first section, the respondents gave their subjective assessments about automatic and manual *remixes as memorabilia*. They were asked to watch the five remixes: Auto1 and Auto2, and Manual1, Manual2, and Manual3. (Man# and Auto# in the paper). They were then asked to respond to the claim: "This remix works very well as memorabilia from the concert". They were also asked for a rationale in an open-ended field and to put the remixes in order based on their overall quality. The labels of Auto1 and Man1 did not indicate whether they were manual or automatic but this information was visible in the other remixes. However, we found that the labeling did not influence the ratings significantly.

In the second section, we concentrated on how much people want to *have control over their video clips*. We presented claims concerning sharing video clips to other actors to be remixed (Actors: the artist, an unknown concert attendee, the AVRS). We presented three claims related to each actor. The claims were as follows: If the [actor] is the one who makes the public remix, I'm willing to share my clips 1) immediately after recording a video clip, 2) after viewing the video clips, and 3) after watching the final video remix.

In the third section, we asked about people's *willingness to receive public acknowledgment* if their clips were used as part of a video remix. We presented two claims and an open-ended question about willingness to get one's name published as part of the video remix. The claims were again presented three times, separately concerning each actor. In the open-ended question, we asked about their reasons for wanting or not wanting acknowledgement.

RESULTS AND DISCUSSION

The questionnaire was sent to 43 participants of the field study via email. 19 responded (ten males and nine females for a response rate of 44%). Since we did not want to force people to respond, N varied for the different survey items.

Automatic remixes as memorabilia

The results of rating automatic and manual remixes show that the best of the manual ones were perceived as better than the automatic ones overall (Table 1). Man2 and Auto2 were significantly different (Mann-Whitney, p=.036). The remixes separated into two groups, Man3 and Man2 being significantly better in overall quality than the rest (unadjusted for multiple comparisons).

However, when the participants were asked to rate the same video remixes based on their value as memorabilia, the remixes were rated much closer to each other (Table 1, the next page). Man1 had a median of 2 and all others were 3

Rank: Please, order the remixes based on overall quality. **Claim:** This remix works very well as a memorabilia from the concert.						
Remix	**Rank**	**Claim**	**Rank**	**Claim**	**Rank**	**Claim**
	Median		**Mode**		**N**	
Man3	5	3	5	3	16	12
Man2	4	3	4	3	16	11
Auto2	3	3	3	3	16	11
Auto1	2	3	2	3	16	11
Man1	1.5	2	1	3	16	11

Table1. Rank: Order based on overall quality. (1=worst, 5=best); Claim: Personal memorabilia value. (1=disagree, 3=agree)

(scale 1= disagree to 3 = agree). A significant difference was found only between Man1 and Man3 (Mann-Whitney, p=.038). The results indicate that, although the automatic remixes were not perceived to be as good as the best manual ones, they were still perceived to be good memorabilia.

In the open-ended questions, some of the respondents described the automatic remixes as a bit convoluted and bumpy. However, many also described the automatic remixes as representing the overall atmosphere well. They also noted familiar angles of view:

"I was in the front of the stage. There the atmosphere was different than at the back: jumping, raging…Because the picture was shaky in places and the cuts were fast, this remix was able to capture my concert feeling."

The need for control of clips

We sought to study if users' need for control of their clips depended upon the actor with whom the clips were to be shared. As such, we compared control variable scores of the three actors (Table 3). Significant differences were found between AVRS and Peer (Mann-Whitney, p=.029) as well as between Artist and Peer (Mann-Whitney, p=.038). Interestingly, this finding implies that respondents preferred to hand over clips to the AVRS over an unknown peer. It might also be that in the case of the artist and the AVRS as the actor, the users did not feel a need for control because they trusted these entities more than an unfamiliar person. Trust itself always involves risk [8], and is crucial in systems of distributed agency like our collaborative video remixing where labor is allocated to external actors. It might be that the participants feel that the risk involved in their clips being used in an unpleasant way is greater with a peer as an actor compared to the AVRS or artist. They might perceive the AVRS as "deterministic" and incapable of "abusing" the material, and trust that AVRS will not violate their impression management goals. Also in a long run, trust on the system may change depending on the type and frequency of possible faults. Fault in this case would occur if a user was associated with a published video remix that is not in line with the public profile she is building.

Claims: If the [actor] is the one who makes the public remix, I'm willing to share my clips 1) immediately after taking a video clip, 2) after checking the video clips, and 3) after watching the final remix.				
Actor	**Median**	**Mode**	**Reliability**	**N**
Artist	5.5	4	α=.823, 1.comp. 74%	18
Peer	7.5	9	α=.718, 1.comp. 66%	18
AVRS	6.0	6	α=.729, 1.comp. 65%	18

Table3. Need for control of clips (3=low, 9=high). Sum variable from three claims: 1), 2) and 3). Cronbach's α and PCA's 1. component as reliability measure for sum variable.

Attitudes for public acknowledgement

Based on medians and modes (Table 4), we can see that most of the participants do not want to get public acknowledgement when the AVRS makes the remix. However, most of them did want to receive authorship if the artist made a video remix. We believe this finding might indicate that the respondents perceive the AVRS as a black box. The artist, on the other hand, represents something that the participants probably want to be associated with. Nonetheless, the differences between the actors were not statistically significant (Mann-Whitney, $p<0.05$). Based on median and mode values, the respondents were less likely to want to see the final video remix before deciding whether to be acknowledged in the case of the AVRS than in the cases of peer and artist as actors. In this case also, the differences were not statistically significant.

The open-ended question on whether and why the participants (N=16) would like to be publicly mentioned as the authors of the final mix (regardless of who made the remix) showed that half expected acknowledgement. More importantly, acknowledgement expectations were divided among conditional and definite opinions. Only a few participants expressed an unconditional desire for acknowledgment or desire for publicity ("definitely yes"). The people who expressed a conditional need for acknowledgement would like to provide their consent after their evaluation of their own or the final content. There were several reasons for not wanting an acknowledgement. For example, one participant said that because of professional reasons he does not want his name to appear on the Internet. Many respondents indicated skepticism towards the technical quality of the recording, their own capacity, or the quality of the final video remix. Identification concerns were evident because the

Claim: If the remix made by [actor] includes my video clips, I want my name to be mentioned in the remix.			
Actor	**Median**	**Mode**	**N**
Artist	3	3	18
Peer	2	2	18
AVRS	2	1	18
Claim: If the remix is made by [actor], it is important for me to see the complete remix before I decide if I want my name to be published as part of the remix.			
Artist	2.5	3	18
Peer	3	3	18
AVRS	2	2	18

Table4. Attitudes on acknowledgement (1=disagree, 3=agree)

people did not want to be associated with dubious publications nor with dubious forums. One respondent mentioned consideration of fair use, the need for awareness of commercial or any other type of use that was previously unknown. No one explicitly expressed a need for individual parts of the video remix to be attributed to them.

CONCLUSIONS AND IMPLICATIONS FOR DESIGN

Based on the results about how people perceive collaborative automated mobile video production in live music context, we draw the following conclusions:

For memorabilia, remixes do not have to be perfect

The overall quality of the automatic remixes did not match the quality of the best manual remixes. However, the automatic video remixes were perceived to be as good as memorabilia as the manual ones. This finding indicates that the video remix does not have to be superb in order to trigger memories from the music event. One way to provide that emotional response is to offer varied perspectives of the event through different camera angles. This technique allows people to relate to the video because they see views from places they themselves had occupied during the show.

Proper control helps to hand over the clips

People need significantly less control of their personal clips when sharing them with an AVRS, as compared to other concert attendees with whom they are not familiar. We believe that this result indicates that the automatic remixing system was seen as trustworthy with regards to sharing one's personal video clips to be used in creating a public video remix. With an AVRS, a user veto may not be required before publishing the automatic video remix. However, users should not be hurried into handing over their video clips to the system either; they should have a chance to preview their clips. Only the clips that are explicitly chosen should be included for remixing.

No to automatic acknowledgement

Novice users are uncertain about the outcome and thus unlikely to want to be acknowledged without the chance to review the video remix. The willingness to share is largely dependent on the quality and subjective meaningfulness of the final content as well as the reputation of the venue where the final content will be published. It seems that people want to be aware of how they are presented as part of the outcome and want to control it in such a way that matches their impression management goals. Since many of the participants did not expect acknowledgment and many saw it as very conditional, we do not think people should be acknowledged as a default, unless they separately agreed to do so. Users should be informed from the start about the intended use and licensing. However, they should not necessarily be asked for consent for acknowledgement at an early stage, either before recording or after uploading the material. If after production consent is impractical, the decision should be made thoughtfully.

We hope that our study will be a useful reference for designers of video production tools who need to know peoples' perceptions on collaborative video remixing and how to deal with control and acknowledgement issues.

ACKNOWLEDGMENTS

We thank Provinssirock, Fullsteam Records, Lapko, Disco Ensemble, and Teosto organizations. Anonymous CHI reviewers, and additional researchers Lassi Seppälä, Suvi Silfverberg., Arto Puikkonen, Pirkka Åman, Francesco Crikri, and Vilma Lehtinen for organizing the study. Academy of Finland project MusiQuitous funded work at HIIT.

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Cross-use of Smart Phones and Printed Books in Primary School Education

Sami Vihavainen
Helsinki Institute for Information Technology HIIT / Aalto University
00076 Aalto, Finland
+358 44 348 2517
sami.vihavainen@hiit.fi

Timo Kuula
VTT Technical Research Centre of Finland
P.O. Box 1000, FIN-02044 VTT
+358 40 489 0268
timo.kuula@vtt.fi

Maija Federley
VTT Technical Research Centre of Finland
P.O. Box 1000, FIN-02044 VTT
+358 50 511 8089
maija.federley@vtt.fi

ABSTRACT
The adoption of new technologies in primary schools has fallen behind in terms of children's everyday use of technology. The use of mobile phones has been proposed as a promising field for learning. To date, the mobile learning technologies have rarely been integrated with current educational practices, however. Here, we present the results of our intervention study in which a mobile hybrid media system that combines the use of the traditional printed book with the mobile phone was used in English as foreign language (EFL) education in primary school. The results revealed an increase in learning motivation but also some conflicts when the boundaries of the school world and everyday life were blurred through the use of new technology.

Categories and Subject Descriptors
K.3.0 [**Computing Milieux**]: Computers and education – *General*

General Terms
Design, Experimentation, Human Factors

Keywords
Education, mobile, intervention, print, user experience, English as foreign language, EFL

1. INTRODUCTION
The everyday lives of children have been affected by a myriad of new digital media technologies. Ever-younger schoolchildren may have their own handhelds for digital media creation, capturing and sharing, while printed books and pencils are still the primary media technologies in schools. If mobile devices are finding their way into classrooms anyway, through pupils' pockets, educational practices could also include the use of these technologies in productive ways [6]. This is a challenge for the current culture in schools.

The development of learning technologies has previously been strongly divided. Printed books and digital learning technologies have been developed separately. Considering the wide use of digital technology in everyday life and the trend to continue using printed material in schools into the future [5], we saw a clear need to converge the two worlds. In this paper, we present our intervention study in which a hybrid media learning system, a combination of digital and printed media, was used as part of primary school education. In our case, the combination of digital and print meant converging the mobile phone with the printed book.

We believe it is important to explore the possibilities of combining digital and print in the school environment for two reasons. Firstly, we feel that new technologies should primarily be introduced because they benefit the end-user and not for, for example, political or economical reasons. This is also important in a learning context. Secondly, we see the end-users as three primary stakeholders: pupils, teachers and parents, who all should react positively to the new learning technology. Also the stakeholders should be on the same page with regard to the limits and possibilities of the technology. We consider these issues relevant to the MobileHCI community, because whenever we design new technologies we should take into account current practices and take care of usefulness of the new technology.

We ended up with two research questions: 1) How is mobile hybrid media used in primary school teaching? 2) What is the user reaction to mobile hybrid media in primary school teaching?

To study the implications of the hybrid media learning system in primary school teaching, we conducted an intervention study in a Finnish primary school. As a case system, we used a convergence of the printed schoolbook, IMediaLink image recognition software developed by VTT (Technical Research Centre of Finland), and three types of mobile hybrid media exercises that were developed during the earlier phases of the project.

1.1 Related research
In the field of mobile learning, English language is a particularly popular subject for research. According to a number of studies, mobile technology offers easy access to audio-visual materials and thus possibilities to enhance English learning [1][7][8]. Learning on the move, the opportunity to listen to podcasts and instant access to the Internet are examples that have been listed as key benefits of using mobile technology in language learning [4]. "Fun" and "coolness" were also reported as benefits [7].

The results of a study comparing vocabulary learning from a paper book and a portable eBook device showed that pupils preferred paper books for their portability, ease of use, lack of strain on the eyes and because they could annotate the text. The mobile devices, however, enabled them to perform tasks such as quickly looking up the meanings of words [3]. These results clearly indicate that digital and printed media both have special advantages, and from our viewpoint the two should be combined.

MobileHCI 2010 September 7-10, 2010, Lisbon, Portugal.
ACM 978-1-60558-835-3.

1.2 The mobile hybrid media learning system

To trigger the digital content of the printed book, the user starts the IMediaLink application from her mobile phone. With the IMediaLink, the user takes a photo of a page in her schoolbook (Fig. 1 left) and the application sends the image to the server, where it is analyzed and the equivalent web link is searched from the database and returned to the user's phone. The phone's web browser opens a link which contains a list of school exercises for that specific chapter of the book (Figure 1 right picture). From this list, the user then selects the exercise he or she wants to do.

We developed three exercise types. First, in *Missing words* the user is given multiple-choice questions in which he or she tries to select the correct word from a list to complete a sentence. The exercise is adaptive, i.e., the user is given easier or more complicated sentences, depending on her previous performance. Secondly, in the *Crossword* the user is given an audible hint from the phone and tries to write the correct word in the crossword on the phone. Thirdly, in the *Listening exercise,* the user listens to the chapter text from her phone and is able to follow the text in the book at the same time. Our system also contained a *web interface* for the teacher to follow when a pupil had accessed an exercise with her mobile phone.

The exercises were developed in the early phase of the project in collaboration with professional developers of school material. The development process was an iterative study-design-build-evaluate process. This intervention study was the evaluation phase of the fourth iterative round. Prior to this intervention, book designers, pupils and teachers were interviewed about the needs of new learning technologies, a number of concepts were designed and built, the concepts built were evaluated in user tests, and exercises were chosen for the intervention study (see [5]).

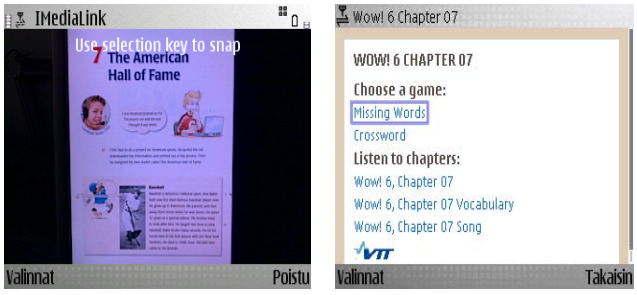

Figure 1. User's view of the phone screen when linking the printed book to the mobile exercises

2. THE INTERVENTION STUDY

To study the implications of the system, we conducted an intervention study. The study was carried out at a primary school in Southern Finland. We recruited a Year 6 class (25 pupils aged 12: 11 girls, 14 boys) and their English teacher to use our hybrid media learning system. The English teacher also participated in some of the earlier concept development phases. We chose a state primary school for a natural representation of the Finnish basic education system. We used a mix of qualitative (interviews and personal diaries) and quantitative (questionnaire, logs) methods to capture subjective views of the system and data on the interaction with the exercises.

All the pupils and the teacher were given Nokia E71 smart phones and free, unlimited data plans. The technological infrastructure was pre-installed and the phones were ready to use. The participants were introduced to the phones, IMediaLink and the exercises in a group session in which everyone tested that her system worked properly. The class used the system for three weeks. During the study, the pupils had six English lessons and used the system as part of the learning material. The pupils were allowed to use the phones freely in their everyday lives, including outside school. The only restriction was that the calling time and SMS use were limited to a moderate amount.

Eight pupils, the English teacher and four parents were *interviewed* after the study. The pupils were interviewed in pairs to ease nervousness during the interview. The interview consisted of questions about the interviewees' demographics, their relationship with the school environment, prior experience of information technology, user experience of the mobile phone during the study, and user experience on the hybrid media system as part of the learning experience. Approximately five hours of interview data were gathered. The *data logs* contained time stamps of each pupil's use of the exercises: the number of times an exercise was accessed and the user's result when he or she completed the exercise. The data logs were used to monitor the activity and select active and inactive pupils for the interview sessions. A shortcoming of the data was that we did not have the individual user's data from the Listening exercise. The *questionnaire* contained questions on the user's experience of the tested system. The questionnaire was a modification of the one used by Brooke [2]. All the pupils filled in the questionnaire after the intervention phase. Each pupil was given a *personal diary* in which he or she was able to make notes on whether he or she used the system in or outside school and what kind of positive and negative experiences he or she had had with the system. The diaries were used in the interviews to make it easier for the interviewees to remember their experiences during the intervention phase.

3. FINDINGS

In this part we describe how the system was used inside and outside school, and how each stakeholder responded to the system.

3.1 Use of mobile hybrid media in education

From a broad view, the system fulfilled the main functionality for which it was designed, as part of the educational material for learning English as a foreign language in a primary school context. Although the system was new to all the stakeholders and some usability issues arose, the overall user experience was positive and pupils learned to use the system quite easily. As the teacher said: "The kids are so clever with all the new technology." None of the interviewees thought the system was pointless. The exercises were used quite actively. Table 1 shows how often each exercise was loaded and the ratio of pupils who loaded them.

Table 1. System activity among the pupils

	Missing words	Cross-word	Listening
Times loaded	**40**	**21**	**54**
Pupils who loaded it at least once	**72%**	**48%**	**~100%**

3.1.1 Use in the classes – motivating but requires pre-planning and induces loss of control

In the classes, the exercises were carried out under the supervision of the teacher. The use of the new system required the teacher to prepare for the classes from a new angle. As she said: "A normal class timetable would not have worked." The teacher did not feel that the pre-planning was too laborious however.

In the classes, the teacher instructed the pupils to do the Listening exercises. This was the main reason that the listening exercise was loaded most (Table 1). First, the pupils listened individually to the chapter on their phone and then they continued working in pairs, face to face. The mobile phone listening exercise replaced the CD that the teacher had played for the whole class during the lectures. As a result, the pupils were able to go at their own pace, and there were fewer distractions. The Missing Words and the Crossword were given as extra exercises or homework. They were not mandatory and the teacher did not use the results in the assessment. Nonetheless, 72% had loaded the Missing Words and 48% the Crossword at least once.

The technology itself seemed to motivate the pupils to concentrate on learning. According to the teacher, with the exciting technology, she was able to "lure" pupils to learn. Some pupils made the same observation: "This might be motivating to pupils who do not like to study so much." – girl, 12 years.

In several interviews it came up that when the teacher had instructed the pupils to do exercises with the phone, some pupils had played games or browsed the Internet without the teacher noticing. Pupils have of course always done things that are not allowed, but it seemed that in this case, the technology had given them more freedom to do activities in secret from the teacher: "Some boys only played the formula game and the teacher did not notice at all." – girl, 12 years.

3.1.2 Use outside the classroom – New rules and new explicit social interaction

The pupils were allowed to take the phones home with them, and the teacher had given them our mobile exercises for extra homework. The opportunity to use a smart phone with an unlimited data plan brought up new challenges at homes.

Many of the interviewed pupils said that their parents were interested in hearing about the new system, but did not have the time to learn in more detail what the pupil did with the system. None of the interviews (parents or pupils) revealed that a parent had actually tried how the system worked. The interviewed parents said that they have set limits for their children's Internet usage at home. It seemed that many of them did not realize that a smart phone with an unlimited data plan was much like a computer with Internet connection however. As one father said: "It is very hard to believe that my daughters would use the Internet on the phone." One mother had set strict rules that the computer (including the Internet) could only be used after homework had been done and not after 8 pm. She found that her son was still browsing the Internet on his phone after bedtime however. After that, they made new rules for the phone use too.

Doing homework with the system allowed the teacher to use the teacher's web interface to monitor when a pupil had accessed the exercises. The teacher did not think it important to use the monitoring system in this case, however, because this was a study and the exercises were "kind of extra work". Instead, she had instructed the pupils to send text messages to her when they had done their homework. This, she said, was an explicit way to communicate with the children outside the school: "Some otherwise shy kids sent text messages and that felt really good."

3.2 User reactions to mobile hybrid media

In a nutshell, the response was positive. The stakeholders' views of the system echoed this on some things but differed on others.

3.2.1 Teacher's reactions – "Like magic, but should be easy"

The teacher was committed to trying the system with her class. In her own words, she was not very "tech savvy": "I am this kind of average bumbler with technology." Despite not being "tech savvy", the teacher did not seem afraid to use the system. Usability issues came up when the teacher described how some of the pupils were unable to access the exercises using IMediaLink. During the interview, the teacher emphasized ease of use of the mobile exercises, though she said that the system was generally effortless for the pupils and herself to use.

According to the teacher, the combination of a printed book and a mobile phone was a welcome update. She was not ready to give up printed books, however, but felt that mobile exercises were a flexible and motivating addition to traditional educational material.

The teacher also wanted to raise the issue of free education in Finland and emphasized that Finnish law states that everyone has the right to free basic education. Parents can therefore not be required to pay for smart phones and data transfer.

3.2.2 Pupils' reactions – "It's a phone not a book"

The pupils were keen to have smart phones and excited because they were allowed to use their phones during classes. Adding an everyday media device like a mobile phone to a class context was something they were not used to, and it felt exciting. The pupils were able to adapt quickly to the technology, and they actively helped each other if anyone had problems using it.

After the study we asked the pupils to evaluate the printed book and the smart phone in educational use. We asked whether they wanted to use mobile phones often for learning. Out of 21, 20 answered 4 or 5 on a scale of 1 to 5 (5=strongly agree). When we asked whether they thought the printed schoolbook could be put aside completely, only 9 pupils clearly agreed (answered 4 or 5).

3.2.3 Parents' reactions –"Finally some update from our times, but what would this cost?"

All the interviewed parents thought that an effort to update educational material from their times was very welcome. As one parent said: "Teaching is still awfully outdated."

All of them also said that the printed book should not be replaced, however, and that it is important to work with something concrete that is also long lasting: "It is important that pupils get something that will last. Print supports that. Otherwise everything might vanish into cyberspace."

Some also brought up that some just like to use the printed book and some a mobile phone. A combination of the two would allow a greater proportion of pupils to be motivated.

All of the parents also talked about the financial requirements the new technology might bring. Many made a strong statement on how education in Finland is provided by the government from the taxpayers' money. It should not require people to pay extra and put people in unequal positions because of their wealth. Some of the interviewees said that they might be ready to pay some minor extra costs however.

4. CONCLUSIONS AND DISCUSSION

Our experiences from the test period indicate that mobile hybrid media is a suitable learning technology for primary education. The motivation of teachers and pupils was high, and the attitudes of parents supported the use of hybrid media. A few problems with the technology did not seem to reduce the enthusiasm of the pupils and teacher. We see that combining the familiar with the new, in this case print and digital, helps to integrate new technologies into current practices within the teacher communities.

It is worth noting that the phones were probably not seen very much as tools for schoolwork by the pupils, but as tools for doing other things outside the school context. The sense of "forbidden fruit" may have affected the pupils' opinions positively during the test. Our user study verified the *high potential* of the mobile hybrid media in schoolwork however. A longer test period is required to prove actual benefits for learning.

We saw that our intervention caused changes in normal school practice: the teacher had to plan "mobile lessons" differently and she created the SMS task herself. Manual reporting by SMS worked better than the automatic monitoring interface, and there was a new kind of explicit interaction between the pupils and the teacher and some blurring of the line between school and leisure. The parents' understanding of the mobile phone tasks was probably not as clear as of the usual school tasks, and they had to put some extra effort into controlling their children's' use of the test phones as well. Even though these changes were most probably caused by the short test period and, in this sense, the situation was unnatural, the use of mobile technology is likely to change familiar practices. It is therefore important to pay attention to all the stakeholders when introducing new technologies such as the mobile hybrid book into schools.

To conclude this paper we present some implications for design. Some of them are classical findings of human computer interaction, but we see it important to remind about these in learning context.

- In order to enable innovations by the teachers the technology should be flexible and easy to understand.
- The appropriation of new learning technologies is a socially constructed process where multiple stakeholders negotiate the rules and conventions for technology use. Thus real life experiments are in important position in devolving new learning technologies.
- A two-way manual homework reporting system supports explicit interaction between the pupil and teacher, and can be more pleasant than a fully automatic monitoring system.
- The system should also provide access to digital learning materials offline. Uploading content from the Internet each time it is used is often too slow, unreliable and costly.
- The extent of Internet access via mobile phones should be carefully planned in school context.
- In Finland, cost-free primary school is an important value. Mobile learning must therefore not incur direct costs to the end-user. Some minor costs may be acceptable however.
- A combination of the printed book and mobile phone supports different learning styles and gives the teacher flexibility in her teaching.

5. ACKNOWLEDGMENTS

This study was a part of a Learning by hybrid media-project, funded by TEKES, UPM, StoraEnso, Myllykoski and M-Real. We want to thank Anu Seisto for project management, and Janne Pajukanta, Antti Aikala and Jouko Hyväkkä for organizing the technical infrastructure. We also want to thank WSOYpro, especially teacher Pirjo Pelto.

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The Clash between Privacy and Automation in Social Media

Sami Vihavainen[1], Airi Lampinen[1], Antti Oulasvirta[2], Suvi Silfverberg[1], Asko Lehmuskallio[1, 3]
[1]Helsinki Institute for Information Technology HIIT, Aalto University
[2]Max Planck Institute for Informatics, [3]UC Berkeley School of Information

I. ABSTRACT

Classic research on human factors has found that automation never fully eliminates the human operator from the loop. Instead, it shifts the operator's responsibilities to the machine and changes the operator's control demands, sometimes with adverse consequences, called the "ironies of automation." In this paper, we revisit the problem of automation in the era of social media, focusing on privacy concerns. Present-day social media automatically disclose information such as users' whereabouts, likings, and undertakings. Our review of empirical studies exposes three recurring privacy-related issues in automated disclosure: 1) insensitivity to situational demands, 2) inadequate control of nuance and veracity, and 3) inability to control disclosure with service providers and third parties. We claim that the "all-or-nothing" type of automation has proven problematic and that social network services should design their user controls with all stages of the disclosure process in mind.

Keywords
Social media; privacy; automation

II. INTRODUCTION

Numerous popular social network services (SNS), such as Facebook, Twitter, and Foursquare, have introduced automatic means of information disclosure. For example, users can now automatically assign location information to their status updates in Twitter and Facebook, and Foursquare users can automatically broadcast their "check-ins" to physical locations. We are now witnessing only the beginning of automation in social media: with computers increasing their sensing capability (e.g., sensors and tracking of service use), more and more of the users' undertakings and likings can be automatically captured and disclosed to others. The rationale for automation is obvious: in principle, it decreases user effort for a task, helping to amplify online content creation. Ideally, when a sufficient number of users start sharing pieces of information in real time, the value of an SNS increases for the users, the service providers, and possible third parties.

In this paper, we argue that automated disclosure can threaten privacy by requiring a change to the users' routines to regulate it. In 1983, Lisanne Bainbridge [1] wrote her classic article on "the ironies of automation." She studied automation in process industries and suggested that the irony of automation is that the more advanced an automated system gets, the more crucial the role of the human operator becomes. Humans still need to monitor the operations and take over in abnormal conditions, and automation leads to deskilling, avoidance of responsibility, and neglect. Analogously, we claim that the irony of automation in SNSs from the privacy perspective is that the more advanced automation gets, the more crucial it is for the user to have control strategies for regulating automated disclosure with others.

In opening up the issue of automation in SNS, we have two main goals. First, we review empirical evidence from recently published studies to learn about the implications of automation on social interaction. We revisit data from three real-world case studies, including location sharing, sharing of music listening data, and sharing of digital photographs. These cases show that increasing automation creates a host of problems for social interaction. Second, we want to understand the link between automation design and privacy-related concerns to inform the design of new features and services. Earlier research has established the notions of "control" and "feedback" as important concepts in ubicomp-supported social interaction [2, 3, 4]. However, these concepts have remained elusive because the design spaces of control and feedback are enormous. To address this issue, we utilize and develop the "model of types and levels of automation" (henceforth "automation framework") by Raja Parasuraman et al. [5] to expose the multiplicity with which functions can be allocated between the user and the SNS. To bind the analysis specifically to privacy, we will utilize the concept of privacy from Irwin Altman in concert with the automation framework.

III. THEORETICAL BACKDROP: PRIVACY AND AUTOMATION

People share content online primarily to interact with other people, and the SNS is one possible mediator in this process. Thus, when it comes to privacy in the domain of social media, questions of automation are complicated by the fact that users need to negotiate control both with the system and interpersonally also beyond the system. To support our focus on social interaction, we consider *privacy* as "an interpersonal boundary process by which a person or group regulates interaction with others," following social psychologist Irwin Altman's interactional approach [6, p. 6]. At the core of the approach is the *boundary regulation process*, in which people optimize dynamically the level of openness and closeness of the self (or of one's group) to others. People's desires for interaction, such as the preferred degree of closeness, vary over time and from one setting to another. Altman's theory has been popular in human-computer interaction research [7] and in research on SNS [8]. However, the question of *automated* disclosure in SNS has not been addressed directly.

In this context, we use *automation* to refer to a computer that replaces the human partially or fully in the task of disclosure. Our approach is based on Raja Parasuraman et al.'s [5] automation framework, which originated from the human factors context. They emphasize that automation does not have to be "all or nothing"; instead, it can be executed on various levels, and the level of automation can also vary from one stage to another during the processed task. The distribution of automation across the processing stages also influences the users of SNS. Their model is a matrix whose first dimension contains ten levels of automation, each offering a certain amount of direct control and/or feedback (Figure 1). On level 1, the user does everything manually, and on level 10, the computer ignores human completely. On levels 7 to 9, the system gives the user feedback about the machine's doings. On levels 6 to 2, the system both gives feedback and offers the user direct control to stipulate the machine. The second dimension consists of four types of stages within the processed task: *data acquisition*, *data analysis*, *decision selection*, and *action implementation*. In

the *acquisition* stage of the task, the raw data of the to-be-disclosed content is acquired. In the *analysis* stage, the acquired data is analyzed, such as aggregating it with other data or comparing it to a database. In the *decision selection* stage, the specifics of the information are selected, such as the information's form and accuracy level. In the *action implementation* stage, the actual disclosure is implemented. For example, in a predictive texting system, when the user writes text using a keyboard, the system senses the taps (level 10), analyzes what word the user is trying to write (level 10), decides on the word and shows it to the user (level 7), and implements the use of the suggested word if the user approves it (level 5).

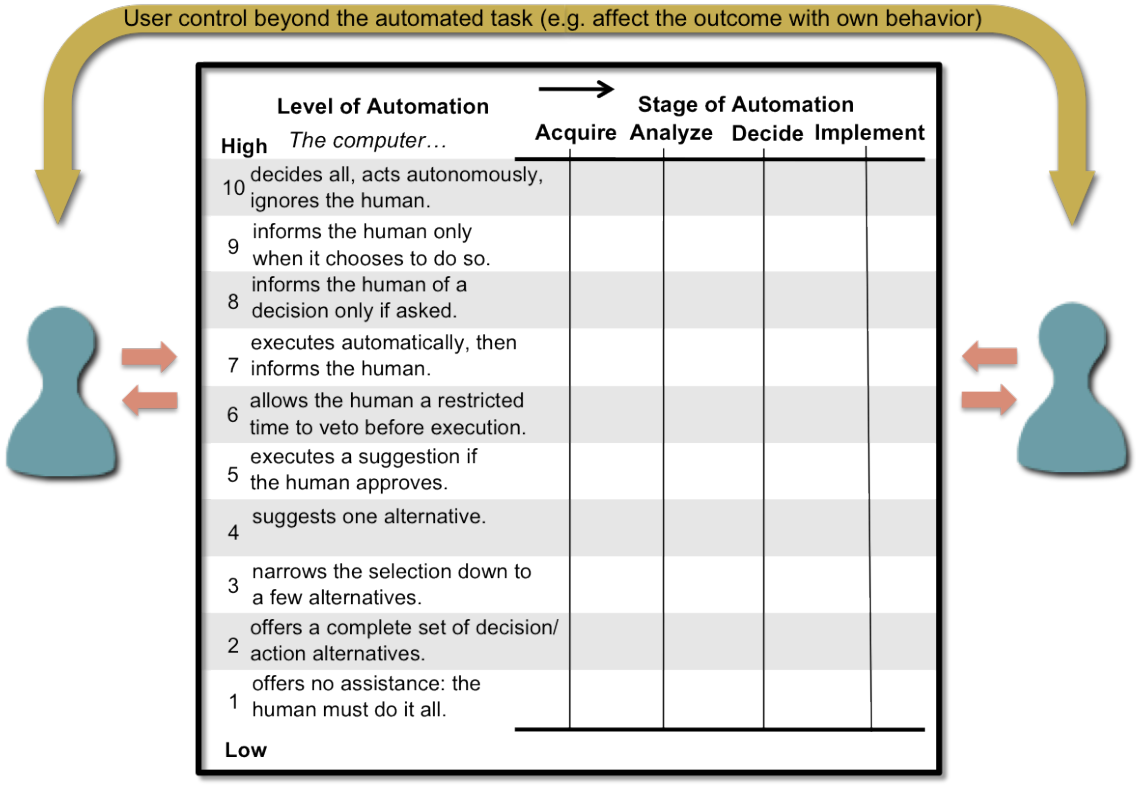

Figure 1. A framework for understanding automation in computer-mediated communication, including the levels and stages of automation of [5] and interpersonal boundary regulation beyond the computer system (yellow arrow).

The notion of *control* is important in this context. In SNSs, a user can directly influence the actions of technology within the limits of the level of automation. This sets a challenge for high-level automation since it restricts the user's control over interaction with others. However, in the case of SNS, users can also regulate interaction *beyond* the actual automated task by changing their behavior or by making corrective social or technological actions (e.g., a priori configurations) before or after the automated task. We depict this in Figure 1 with the upper arrow. This is different from classic automation settings, such as cockpits and control rooms, where the process is controlled only through the system.

IV. SIDEBOX 1:
AUTOMATING SOCIAL NETWORK SERVICES: CASES

We revisit studies from three original articles that focus on privacy concerns related to automated disclosure through three SNSs: Jaiku, Last.fm, and Meaning (Table). The cases describe different types of content and levels of automation.

Service	**Study**	**Findings Overview**
Jaiku is a mobile awareness SNS where users can post brief status messages (≤ 140 characters), for contacts to view. This can be done via a mobile app or an Internet browser. In concert with user-written messages, location labels and awareness cues are automatically updated and shared.	Three user groups used Jaiku's *automated location sharing*. The main interactions were coordinating activities and ad hoc encounters in everyday settings [9].	Unsuitable automation could preclude use in a group in everyday settings. While one group found automated location sharing useful, another was indifferent toward it, and the third group stopped using the system almost entirely, often due to privacy issues.
Last.fm is a music SNS. An extension called the Scrobbler automatically publishes listening information to the user's Last.fm profile, making it public. Last.fm works also as a music recommender system.	Users used *automated music profiles* for expressing themselves and establishing new relationships [10].	Users felt a need to change their music listening behavior and develop impression management strategies as their music listening became public.
Meaning is a mobile photo-sharing SNS. It can be used to automatically publish a just-taken photo in the user's Web album. In addition, it is possible to add user-created metadata and automatic context metadata to the photo. To view the photos in the Web album, one needs to know the album's password.	In a kindergarten setting, children used fully *automated photo publishing* to communicate daily activities to their parents. Also, teachers took/shared photos but with lower automation. Before uploading, teachers were able to add manual metadata [11].	Automated photo publishing created social pressure in the kindergarten environment, as the teachers felt that they did not have enough control over the photos the children took and published on the Web service for their parents to view.

Table. Analyzed services, interaction in the case studies, and the main results in corresponding publications.

V. STUDIES OF HIGH AUTOMATION LEVELS IN SNS

In this section, we analyze the cases described in Sidebox 1 from the perspectives of automation and privacy. As our cases, we have chosen SNS where the disclosure task is highly automated. The levels of automation in all three cases are centered to the higher extreme of Parasumaran's continuum of full automation to no automation at all. Especially in the early stages of the processes, all three systems operate fully autonomously, and the user has no more than two options for controlling these initial operations: ceasing to use the system altogether or changing her behavior according to the system's high disclosure automation. An exception is Jaiku, where the user is able to manually change the location label *after* the disclosure. Although we acknowledge the existence of systems with lower disclosure automation (e.g. [12]), we selected these extreme cases to tease out the potentially adverse consequences of high automation for the boundary regulation process.

In the analysis (see Table 1 for an overview), we concentrate on specific automated tasks. The goal was to show how the automation framework can be utilized in the context of SNSs and to identify the "ironies" caused by automation.

With **Jaiku**, we concentrate on the task of when to disclose a new location label and what the content of the label is. The disclosure process is heavily automated. Parallel to the automated disclosure, the user is able to manually overwrite the disclosed label at any time. Therefore, the user can take corrective action if she thinks that the disclosed label does not fit her privacy goals. The manual label is disclosed until Jaiku senses a new cell ID change. With **Last.fm**, we concentrate on a task of what song and artist to disclose as a label for the current audio track and when is it disclosed. Similarly to Jaiku, the Last.fm disclosure process is heavily automated. However, the user can take corrective action after the disclosure by deleting disclosed items from the music profile. With **Meaning**, we concentrate on a task where a photo taken will be uploaded after capture. Meaning is the most highly automated of the three, although Meaning can be used in other ways as well.

SNS	Acquisition	Analysis	Decision	Implementation
Jaiku	Jaiku senses a user's location based on her cell ID. This stage is fully automatic and operates in the background (level 10).	Jaiku triggers the analysis stage whenever it senses the phone's cell ID changing and analyzes whether the new cell ID has a location name pair in Jaiku's database (level 10).	Based on the analysis, Jaiku decides which location name to disclose (level 10).	Jaiku discloses the location name. Implementation happens beyond the user's control, but the user can see the currently disclosed location name if she decides to open Jaiku (level 8).
Last.fm	Last.fm senses when a user plays an audio track on a device. This detection happens without the user's control (level 10).	Last.fm analyzes the audio ID of the track and compares it to Last.fm's database (level 10).	Based on the analysis, Last.fm decides (identifies) which song and artist name to select as a label for the audio track (level 10).	Last.fm discloses the label to the user's profile. Implementation occurs beyond the user's control, but the user can see the disclosed label by opening her profile page (level 8).
Meaning	In the acquisition stage, Meaning operates in the background, sensing whenever a user takes a photo (level 10).	When a user takes a photo, Meaning immediately analyzes it (level 10)…	…and decides that the exact photo will be published as it is (level 10).	Meaning publishes the photo without any user control or feedback (level 10) by sending (disclosing) the photo to the Web album server for users, such as parents with user IDs, to view.

Table 1. The analysis of control allocation between the user and the SNS within the disclosure task.

To learn about the effects of automation, we revisited the studies in Sami Vihavainen et al. [9], Suvi Silfverberg et al. [10], and Jaana Näsänen et al. [11] to identify privacy concerns across empirical cases that illustrate the role of control from a privacy perspective. We identified 19 instances of privacy concerns in the three cases under analysis. Many of the instances resembled one another and three themes recurred among them. Building on these themes we formed three privacy concern categories: 1) insensitivity to situational demands (user was unable to control disclosure in specific times or places), 2) inadequate control of nuance and veracity (user was unable to control the specifics of the disclosed content), and 3) inability to control disclosure to service providers and third parties (user was unable to control or know what exactly the system was tracking and for what purpose). Table 2 presents examples of the 19 instances of privacy concerns, how they fit into the three solution categories, and what kinds of ironic consequences automation has.

Privacy Category	Examples	Irony of Automation
Insensitivity to situational demands (A concern stemming from the user's realization that she had neglected the disclosure boundary for some time.)	A user of *Jaiku* realized that, when she and another Jaiku participant spent time together, the system was probably disclosing that fact to other users.	Automation in SNS contexts may impose on users a conflicting requirement to regulate boundaries preemptively instead of in situ.
Inadequate control of nuance and veracity (The user was unable to control in detail what kind of image the system presented of her.)	A user of *Last.fm* faced a conflict of whether to listen to what she enjoys or not because some of it did not fit into the type of profile she wanted to build on Last.fm.	Automation, which promises users increased possibilities for expression, may leave them powerless to adjust the socially meaningful specifics of disclosures.
Inability to control disclosure to service providers and third parties (The user felt that she could not control enough organization and third-party access to the photos.)	Parents were concerned that external parties might have access to the photos that their children uploaded to *Meaning*.	As a by-product of the socially meaningful disclosures on SNSs, users end up disclosing information to actors with whom they do not always feel comfortable sharing extensive details about their lives.

Table 2. Examples of instances of privacy concerns and their categorization

VI. RESULTS: IRONIES OF AUTOMATING SELF-DISCLOSURE

The privacy concerns we identified are associated with different ironies of automation in SNSs. All ironies highlight that while automation may leave the user with scarce control over disclosure within the system, the user's capacity and need to regulate the situation socially cannot be bypassed. In addition to reporting on privacy concerns and the related ironies of automation, we discuss alternative design possibilities in light of the various levels and stages of automation and consider alternative designs.

A. Insensitivity to situational demands

One recurring privacy concern is the user's inability to control disclosure *situationally* in accordance with the requirements posed by specific times or places, especially in relation to different people. This concern reflects how people's desire for interaction varies over time and from one setting to another [6]. Predicting how social interactions play out and preemptively explicating one's resulting desires for a system is burdensome at best and impossible at worst.

We found that automation complicates the situation in that systems such as Jaiku may present disclosures from multiple users in aggregation in ways that users did not anticipate. For instance, a user might not realize or might forget that the system can automatically display that she shares a location with another person, highlighting a connection that the users did not mean to disclose. In one case, a user did not realize until too late that Jaiku could have revealed that she and another user had been spending time together while they were logged into Jaiku [9]. This possibility made her worry that others were speculating that they had had an affair:

"Do others now assume we [another participant] have something going on? (...) it might have been better not to disclose that. But if I turn it off [Jaiku], it needs to be done before we meet."

An alternative design solution to meet this demand for situational control could be to increase user feedback during the action implementation stage so that the system would inform the user which of her other contacts are currently disclosing the same location name (change from level 8 to 7) or giving the user a restricted time to veto it before the new location is disclosed (level 6), thus enabling the user to prevent other Jaiku users from associating him/her with co-present others. The trade-off here would arise from the time and added effort required to veto: information disclosure would no longer happen in real time, reducing the users' ability to use Jaiku for coordination.

Similar concerns resulted from the conclusions and interpretations that users' social contacts could make by aggregating disclosed information with what they already knew about the user. Such concerns came up in contexts where those viewing the shared content were familiar enough with the user to combine information in this way.

We observed that Last.fm's high level of automation compromises its users' privacy when they wish to conceal specific songs from other people who are capable of making accurate interpretations of a user's current feelings according to their music selection. For example, a user of Last.fm was aware that her friends were interpreting her mood based on what music she was playing [10]. She did not like that since she believed that her feelings were private. Last.fm's high level of automation prevents users from controlling the disclosure process. Alternatively, designers could augment control by lowering the automation level in the action implementation stage. For example, the designers could allow users to control the times of disclosure. With such a feature, a user could tell Last.fm not to disclose any information about her listening habits for the next 24 hours, after which Last.fm would ask the user whether she wanted it to begin disclosing again (level 3).

Finally, the case of Meaning highlights a further complication for boundary regulation, namely that the person about whom something is disclosed may not him/herself be the one in control of disclosing the content (with the help of automation). The kindergarten teachers [11] reported feeling uncomfortable because some of the photos that their students took were close-ups of the teachers. The teachers admitted that they would have chosen to delete some of the photos the children had sent to Meaning's Web server. While the application did not offer the teachers this choice, they were able to handle the concern by exerting control over what their students were photographing. As an alternative design solution, designers could increase teachers' control by lowering the automation in the action implementation stage. For example, the teachers could have moderator control by forcing the system to ask for a security code before uploading any photo, and only the teachers would know this code. The trade-off would be that teachers could use this to censor photos that present them in a professionally unfavorable way.

Social scientists suggest that people optimize privacy dynamically [6]. Ironically, automation in social media contexts may impose on users a conflicting requirement to regulate boundaries preemptively instead of in situ: users should anticipate and preventively act upon unexpected situations and the automated disclosures that can result from them to regulate their privacy.

B. Inadequate control of nuance and veracity

Highly automated information disclosure raises privacy concerns also due to the users' inability to control the *specifics* of what is disclosed. Optimizing such details of disclosure is a task that is not readily

transferable from the users to a system. The irony here is that, as automated disclosure mechanisms fail to support communicating nuances, systems that promise their users increased possibilities for expression may, in fact, leave them disempowered by disclosures that are ripe for misinterpretation or lessen their wiggle room by making it socially difficult to conceal content.

Users often do not have the option of disclosing less specific information about their state of affairs or even adding to the content so that they can explain the context of their behavior. This is the case especially when others are sharing content on behalf of a user. It is easy to imagine how, with Meaning, the kindergarten children could disclose pictures of their teachers that lack important contextual cues.

Inadequate control of nuance in conjugation with the public nature of playlists in Last.fm profiles often affected the kinds of music that users chose to listen. As making friends with new people who have similar tastes in music is one of the factors that motivates Last.fm use, users are sometimes conflicted between listening to what they want and presenting themselves as they wish in their profiles. To balance these two factors, users wished for the ability to ensure that disclosures would not lack contextual information that they deemed important. For example, a user interviewed in the last.fm [10] study was troubled by her inability to explain the nuances of why she chose to listen to certain songs:

"I have memories of some songs that I've heard in special situations (...), so those you want to sometimes listen to, but you listen not because of the artist but because of those memories."

Alternatively, the designers could allow users to wield more control during the decision selection stage, such as offering the possibility of modifying the name of the song or adding supplementary information as an explanation about listening habits. Last.fm could also analyze users' music tastes and suggest that they pre-modify the to-be-disclosed content whenever they play a track that departs from their usual listening habits. This added control would present a trade-off by possibly increasing the burden of communicating with the Last.fm community. Also, since tampering with what is disclosed might not be considered appropriate among Last.fm users in general, this feature could conflict with the social norms of the Last.fm community. Similar results that call the social meaningfulness of using a system's control mechanisms into question are reported in [13].

Automation and the forced veracity it may impose on disclosure causes privacy concerns also in terms of making it difficult to regulate when one is accessible to interaction with others. For example, a Jaiku user felt that she could not conceal sensitive information from her friends anymore [9]. She referred to instances when a friend called her asking where she was. She felt obligated to tell her friend her whereabouts accurately in case the friend might see her location on Jaiku. However, she could sometimes want to lie about her location. The user experienced unprecedented social pressure to disclose truthfully.

C. Inability to control disclosure to service providers and third parties

The location disclosure and photo-sharing contexts were especially prone to making users feel that they had insufficient control and understanding of what information systems were acquiring, how they were analyzing the information, and for what purposes they were or might be disclosing it. The notion of contextual integrity [14] demands that information gathering and dissemination should be appropriate to a specific context and obey the governing norms of distribution within it. For users, their disclosures in SNSs take place primarily in the context of the social relationships that they foster via these systems. The irony is that, as a by-product of these socially meaningful disclosures on SNSs, users end up disclosing information to service providers

and third parties – actors with whom they do not always feel comfortable sharing extensive details about their lives, such as a continuous record of their whereabouts.

With regard to Jaiku, one user was worried that the system was disclosing her location to unknown people [9]:

"Someone could check when I'm not home and break in to my house."

This concern arose from the user's lack of knowledge about who can have access to her location information: in Jaiku, only one's friends can see one's location.

Another concern related to controlling access is the user's ignorance of whether the service provider is using the tracked location data in undesirable ways. Some users did not like the fact that the Google Corporation, which acquired Jaiku in 2007 (discontinued in 2012), tracked their location data [9]:

"We have been becoming a surveillance society in this country [USA] (...). I don't know where Google stops and the NSA [National Security Agency] starts. All that data is easily used in other purposes."

The problem here arises during the information acquisition and analysis phases, which the corporation conducts before disclosing any information to the user's contacts. The mere tracking of information related to the user can cause a perceived loss of control: once information has been tracked and stored, the individual it concerns is no longer the only one in charge of whether, when, and to whom the information is disclosed.

An alternative design solution could allow more feedback during the information acquisition and analysis phases. For example, Jaiku could actively inform the user that it is sensing and analyzing her cell ID while it executes the location information acquisition and analyzing tasks (e.g., with an icon on the phone's desktop or even by giving the user access to the database with her information). Although the added feedback might make the user more aware of the tracking, it would not address the ever-present threat that a third party could use this volunteered information to gain access to the user's cell phone or for other invasive purposes, nor does it address users' questions over what the service may do with the data later.

Users expressed similar concerns while sharing photos on Meaning. The parents were concerned that external parties might have access to the photos that their children were uploading to Meaning's Web albums [11]. The parents' concerns evoke a wider concern that involves even applications with low disclosure automation. Even when users volunteer information, unwanted parties may access it later, or it may be used in ways that break users' sense of contextual integrity. Low-disclosure automation does not guarantee protection against privacy problems.

VII. Toward User-Centered Automation in Social Media

We started the paper by noting how ubiquitous computing is changing the ways of disclosure in social networks. When designers and developers create new social media services, they now have the option to decide on the appropriate level of automation in disclosure. We have argued that the decision always involves a trade-off. This question has been important and even decisive in the recent history of social media [15].

The takeaway of this paper is that automation changes the demands on users, some of which remain problematic. As found for process industries and in social media, automation does not replace the user but

changes the demands. The need for user control does not disappear, but user involvement is still needed for boundary regulation. High automation causes users to practice control outside the automated system. Users change the way they regulate their own behavior that is capturable by the system, change the system to suit preferences for privacy, and generate auxiliary social mechanisms to ensure correct interpretation. Only against this backdrop can one evaluate whether automation is really enhancing or hampering user experience.

The present article has contributed by reporting three "ironies" of automation in this context. We hope that they facilitate attempts to address the challenge. Three implications are suggested.

First, increasing the level of automation does not necessarily imply a more satisfying social interaction. The three trade-offs we observed detract from users' ability to manage boundary disclosure and, therefore, from their privacy: 1) insensitivity to situational demands, 2) inadequate control of nuance and veracity, and 3) inability to control disclosure to service providers and third parties. Automation, which aims to create satisfying, “effortless” disclosure, introduces novel problems for boundary regulation.

Second, to address these problems, we propose that designers systematically consider alternative levels of automation within the disclosure task. The automation framework is a useful heuristic that guides attention to consider what is done in the different stages of automation: action implementation, decision selection, information analysis, and data acquisition. We emphasize that the selection between user control and automation is a trade-off. Too little automation might bring up new challenges, for example, related to usability. Because the cases we studied concerned high levels of automation, further research is needed to understand the trade-offs associated with the intermediate and low ranges automation.

Third, we believe that the success of a particular automation solution will depend strongly on the needs, practices, and concerns of specific user groups. Automation should never be implemented simply because it is technically possible, nor should one give up on automation based on an assumption that it categorically conflicts with privacy. New technological features have the potential to generate new practices, but, in the end, the user is the one who decides whether using the system is worth the trade-off of changing boundary regulation practices and, perhaps, giving up some of one's earlier ways of regulating disclosure. Although we have talked here about the ironies of automation, we recognize that the automation can potentially enhance people’s communication experiences, and those positive experiences may weigh more than the negative ones. However, when executed in the wrong context and at the wrong level, automation can persuade users to stop using a system altogether.

VIII. OUTLOOK

In this paper, we have focused on the end-users and omitted the other stakeholders’ points of view. Often, however, the SNS is financially valuable to the service provider because it can collect user data and use it to attract advertisers to the service provider. It can be tricky for the system provider to please the users and the advertisers simultaneously. Therefore, an area of research that could benefit designers would be to study how well service providers can reduce the concerns related to privacy by making their privacy practices transparent. We suspect that stronger automation should be linked with more transparent and rigorous privacy practices to gain the trust of the users. However, transparency requires that users understand how privacy practices are applied and what their consequences are. This requires effort from the user.

We are currently witnessing a development where social media services are increasingly aggregating and distributing information about their users. This brings new challenges to privacy research. For example, Facebook launched a new category of third-party applications that introduces the automated sharing of

behavioral data on the site. A prominent example of this new category has been the streaming of music-listening information from Spotify and Rdio. However, as our lessons from Last.fm showed, disclosures that feel harmless on their own may, in conjugate, reveal more than what the user intended. Also, automation design choices are not straightforward. For example, Facebook has evolved through continuous development and iteration. Therefore, we see another important area of research in what happens when multiple pieces of information about a user are automatically aggregated into a single service.

IX. ACKNOWLEDGMENTS

This work was funded by: the Emil Aaltonen Foundation's Social Publicity & Privacy project, Helsinki Institute for Information Technology HIIT/Network Society, the Aalto University's project Otasizzle, the Academy of Finland project AMOVEO, the Max Planck Center for Visual Computing and Communication, and UCIT - Graduate School of User-Centered-Information Technology. We thank the anonymous reviewers for their extensive and useful comments, and Dr. Risto Sarvas for brainstorming for the article and co-authoring one of the revisited papers. Also for co-authoring the revisited papers we want to thank Jaana Näsänen and Dr. Lassi Liikkanen.

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The Authors

Sami Vihavainen is a researcher at Helsinki Institute for Information Technology HIIT and a PhD Candidate in the Department of Human Centered Technology at Tampere University of Technology. His research focuses on user experience of automation in context-aware social media. Vihavainen holds M.Sc. (Tech) in automation engineering from Tampere University of Technology. Contact him at sami.vihavainen@hiit.fi. Mailing address: Helsinki Institute for Information Technology HIIT, PO Box 15600, 00076 Aalto, Finland. Phone: +358 44 3482517.

Airi Lampinen is a researcher at Helsinki Institute for Information Technology HIIT and a PhD Candidate in the Department of Social Research at University of Helsinki. Her research focuses on interpersonal boundary regulation practices in the context of social network services. Lampinen holds M.Soc.Sci in social psychology from University of Helsinki. Contact her at airi.lampinen@hiit.fi. Mailing address: Helsinki Institute for Information Technology HIIT, PO Box 15600, 00076 Aalto, Finland. Phone: +358 50 3016971.

Antti Oulasvirta is a senior researcher at the Max Planck Institute for Informatics in Saarbrücken, Germany. His research interests are human-computer interaction and user interface design. Oulasvirta holds PhD in cognitive science from University of Helsinki. Contact him at antti.oulasvirta@mpii.de. Mailing address: Max Planck Institute for Informatics Campus E1.4 66123 Saarbrücken Germany. Phone: +49 681 302-71927.

Suvi Silfverberg is a researcher at Helsinki Institute for Information Technology HIIT and a PhD Candidate in the Department of Social Research at University of Helsinki. Her research focuses on social network services, online profiles, and integrating social psychology to the understanding of the users of internet. Silfverberg holds M.Soc.Sci in social psychology from University of Helsinki. Contact him at suvi.silfverberg@hiit.fi. Mailing address: Helsinki Institute for Information Technology HIIT, PO Box 15600, 00076 Aalto, Finland. Phone: +358 45 6342709.

Asko Lehmuskallio is a researcher at Helsinki Institute for Information Technology HIIT and a Visiting Scholar at UC Berkeley School of Information. His research interests focus on visual culture and human-artifact relations, especially the ways in which digitally networked cameras mediate our everyday relations. Lehmuskallio holds a D.Soc.Sc. in media and communication studies from University of Tampere. Contact him at lehmuskallio@berkeley.edu. Mailing address: Helsinki Institute for Information Technology HIIT, PO Box 15600, 00076 Aalto, Finland. Phone: +358 50 3841532.

Tampereen teknillinen yliopisto
PL 527
33101 Tampere

Tampere University of Technology
P.O.B. 527
FI-33101 Tampere, Finland

ISBN 978-952-15-3134-7
ISSN 1459-2045